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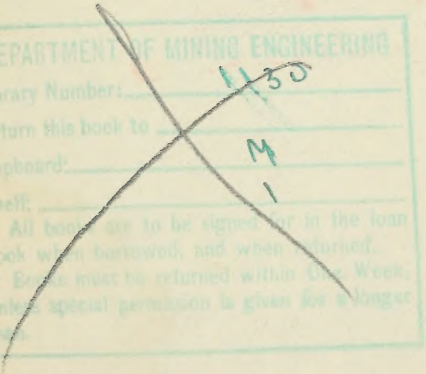
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The Mining Magazine

Edited by T. A. RICKARD.

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EXPLANATORY NOTE.—Items in italics are names of books reviewed; illustrated articles are denoted by asterisks (*); the letters (*c.l.*) refer to notices of articles under the heading 'Current Literature'; the letters (*p.t.*) to abstracts appearing in 'Précis of Technology.'

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Scientia non habet inimicum nisi ignorantem.

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REVIEW OF MINING

INTRODUCTORY.—Since our last issue appeared the course of business has been interrupted by the holidays incidental to the Coronation. During the festivities, and for many days preceding, no business was done. Interest shifted from the City to the West End, from the Stock Exchange to the Abbey. An afterglow of celebration prolonged the period of financial inactivity, but when the tumult and the shouting died, when the Captains and the Kings departed, the whirring wheels of industry again made themselves heard and the chink of money on the counters of speculation once more attracted the man in the street. The low ebb of business during the period of jubilation is indicated by the June 'account' on the Stock Exchange; this was insignificant in its volume. All commitments were curtailed. Even the buying that usually precedes a holiday interruption was notably absent. However, general conditions have continued favourable. Money is easy and the technical position on the Exchange is healthy.

TRANSVAAL. — The statistics for May showed a record gold output of 685,951 oz., worth £2,913,734, this being an increase of 18,237 oz. or £77,467 as compared with April, which, it must be remembered, is a 30-day month. In May last year the output was worth £2,693,785. The chief decrease was at the East Rand Proprietary, owing to the accident. Compensating gains were made by the Crown Mines, New Modderfontein, Simmer & Jack, and Rose Deep. It is apparent that the Transvaal will soon be yielding £3,000,000 worth of gold per month, and the time is near when the maximum production will be attained. At present the new producers are gaining on the expiring mines, but this satisfactory condition is subject to known limitations. According to the last official figures (for March) there were 67 companies and 9911 stamps at work, as against 71 companies and 9836 stamps in May 1910.

We note that the President of the Chamber of Mines recently made a reference to the unexpected competition for Kaffir labour occasioned by railway construction in the Transkei, and he expressed the hope that within a year the mines on the Witwatersrand would have "in their employ over 80% of their declared requirements." On the same occasion Mr. George Albu said that he "viewed with the greatest alarm the constant rise in native labour wages." He advocated co-operative action among the groups, eliminating contractors and other middle-men. Thus the unnecessary competition may be avoided. The labour returns exhibited a decrease of 3936 natives on gold mines as compared with May last year, when the native labour supply showed a gain of 150 on the month preceding. Between May and November last year the decrease, owing to the seasonal migration of Kaffirs, was 5937. A corresponding loss is likely this year. The decrease for June was 3447 natives.

The starting of new mills is indicated by the enlarged tonnage crushed on the Rand. In May 2,002,926 tons were treated at a total cost of 17s. 10d. per ton, so that the average yield of 27s. 6d. left a profit of 9s. 8d. per ton. The cost was threepence more than in April and the yield one penny less; hence the profit was 4d. per ton less; indeed, it was the lowest recorded for 12 months. On the other hand, the total profit of £956,823 was the highest since last August.

Fifteen mines on the Rand have individually contributed over £5,000,000 to the world's stock of gold. According to the figures published by the Chamber of Mines, and quoted

herewith, it appears that the biggest total is that of the Crown Mines, which includes the yield of the Crown Reef, Langlaagte Deep, and Robinson Central Deep, but not that of the Bonanza. The finest showing, however, is undoubtedly that of the Robinson, which, on a gross output of £14,730,170, has given its shareholders the princely profit of £8,199,688. This mine has produced 4,801,075 tons of ore averaging 61s. 4d. or 15 dwt. per ton. The Robinson has had to cede the first place to younger mines, but its record is one of the glories of the mining industry.

Company.	Tons crushed	Value of gold	Yield per ton	Total dividends
		£	s. d.	£
City and Suburban	3,661,020	6,617,300	36 2	2,006,913
Crown Mines	12,369,524	23,548,592	38 1	8,366,235
East Rand Proprietary	10,054,414	17,260,212	34 4	4,977,967
Ferreira	3,257,122	9,225,609	56 8	3,729,250
Ferreira Deep	1,995,393	5,603,074	56 2	2,570,750
Geldenhuis Deep	8,747,691	14,736,486	33 8	3,347,014
Langlaagte Estate	6,483,071	9,637,597	29 9	2,594,105
New Primrose	3,585,426	5,649,670	31 6	2,050,025
Nourse Mines	3,852,641	7,636,291	39 8	1,676,875
Randfontein South	6,285,235	9,883,879	31 5	927,500
Robinson	4,801,075	14,730,170	61 4	8,199,688
Robinson Deep	3,876,728	7,364,577	38 0	2,625,186
Rose Deep	5,351,613	8,420,995	31 6	2,143,125
Simmer & Jack	6,941,486	11,006,945	31 9	3,591,461
Village Main Reef	4,529,260	9,403,847	41 6	2,251,143

Up to July 1 the total dividends declared by companies operating on the Witwatersrand made a total of £4,084,817, with £159,439 more to be credited to outside districts of the Transvaal. Dividends for the first half of 1911 show ten decreases and four increases, the most notable being Crown Mines, reduced from 65 to 55%, and Ferreira from 150 to 100%. Among the increased yields are those of Knights Deep, New Modderfontein, Transvaal Estates, and Worcester. Three companies on the dividend list this time last year have failed to contribute, while two new names appear.

A further consolidation is announced, the Roodepoort United absorbing the Vogelstruis Estate, and thereby gaining 172 claims. This appears to be an excellent move, as the Vogelstruis yields a low-grade ore from which a bigger profit can be won in the larger mill of the Roodepoort United than in its own small plant.

The raising of additional capital for the Geduld indicates an expansion of operations; on the other hand the decision of the East Rand Proprietary to cease operations at the Angelo Deep points the other way and will adversely affect the Cinderella Deep. The increased Modderfontein dividend cheered the market after it had been depressed by the passing of the Durban Deep dividend.

Rhodesia.—The output of gold for May, as given by the Chamber of Mines, was 50,193 ounces, valued at £211,413. This is 2353 oz. or £9883 less than April. In May 1908 the production was worth £223,867; in May 1909, £225,032; and in May 1910, £224,888. This indicates how little real progress is being made, the gain by individual mines being balanced by losses at others. During May the biggest return, as usual, was made by the Globe & Phœnix, which won £39,146 worth of gold from 5760 tons of ore. The production from this mine has been well maintained since January of the current year. Next comes the Giant with £19,080 from 11,988 tons; this being almost a duplication of the April figures. The Lonely, Rezende, and Wanderer exhibit decreases, but the Willoughby nearly doubled

its output, to £11,830 from 8553 tons.

It is reported that a new gold area is being proved in the Hartley district; good prospects have been disclosed on the Turkais, Oleander, and Tea claims. The formation consists of quartz in mineralized schist and resembles the Cam & Motor lode. The London and Rhodesian Co. has taken an option on the Venice and Subi claims in the Umsweswe portion of the Hartley district and is now engaged in vigorous exploratory work. From the Gwelo district also an increase of activity is reported, especially near Hunter's Road. Several Rand speculators have acquired options. In the Enterprise district where promising tin discoveries continue to be made, a check to development has been offered by the excessive prices put on the claims.

Tanganyika shareholders have been cheered by an optimistic cablegram sent by Mr. Robert Williams from Elisabethville. He states that sufficient ore is developed to yield 600,000 tons of copper, and that Mr. Allan Gibb's reports impress him as "masterly." This message was intended for the family, as it were; it expresses the undaunted spirit of a wonderfully energetic promoter, but is not at all convincing. We have read some of the reports of Mr. Gibb and far from being "masterly" we have reason to consider them vitiated by inexperience, or, to be precise, lacking the experience required for so large and difficult a problem as that presented by the metallurgy of the Tanganyika ore deposits. Another message from Mr. Williams announces the starting of the first blast-furnace. Results will soon be available.

Two Rhodesian companies make an initial dividend, the Selukwe-Columbia paying 10% and the Gaika 5%. The Eldorado Banket makes an interim distribution of 15%, as this time last year. On the other hand the yield of the Farvic mine, belonging to Rhodesia, Limited, has declined seriously, as compared with this time last year; and it is reported that development on the lower levels has proved unsatisfactory.

Dr. Hans Sauer gave an interesting summary of Rhodesian mining at the Exploration & Development Co.'s meeting. Of the native labour employed 31% is engaged in development work. This affords promise of an expanding industry. Among the mines undergoing development are at least a dozen that are likely to make a mark, such as the Shamva, Arcturus, and Falcon.

West Africa. — The returns for May showed a substantial increase in the production of gold, the total of 24,427 ounces, worth £96,409, being the highest since May 1909, when the output was 25,104 ounces, worth £100,056. As compared to April the gain is £25,529. For the first five months of this year the aggregate production is 89,133 oz. compared with 84,913 oz. and 144,001 oz. in the corresponding periods of 1910 and 1909 respectively. The recent gain is to be credited to the Prestea, which produced £20,727 worth of gold from 11,080 tons of ore. Slightly bigger returns were also made by the Broomassie and the Bibiani mines. The Offin river dredges are doing better and those on the Ancobra will be doing so when the re-organization of operations has been completed by the new manager. The Ashanti Goldfields, of course, is still the largest producer, yielding 9585 oz. or £41,625 from 9900 tons in May.

The Prestea, Taquah, and Abosso meetings left a good impression. The work of reorganization appears to have been satisfactorily completed. The Taquah at 1650 feet shows 6 ft. of 18 dwt. ore, and it is a curious fact, not unknown in mining, that the original lode which 'petered out' at the 9th level has been found to be overlapped by another lode of a similar character, first disclosed by a cross-cut at the 8th level. We note that Mr. S. J. Weis, the new manager of the Ancobra Exploration & Dredging Co., writes most hopefully concerning that undertaking, having

tested the gravel sufficiently to be satisfied of its richness in gold. A bit of good news comes from the Taquah Central, which has struck a foot of ounce ore at 400 feet. This may not spell profits, but it is distinctly hopeful. The Great Fingall has an interest in the property. At the Adja Bippo, a mine belonging to the Wassau Co., work was stopped owing to a heavy influx of water, caused by unusual rains at the end of May; but a successful effort is being made to unwater the mine from the 8th to the 13th levels.

A year ago much was heard of the banket deposits belonging to the Wallis Syndicate, situated about 60 miles east of the Ashanti Goldfields concessions. The report now issued records that seven shafts have been sunk at the South Reef Main Camp to depths of 67 to 108 ft. and that 640 ft. of driving has been done. Quite unexpectedly the lode has been found to be much broken and faulted, so that it has been difficult to estimate its value. Such sampling as can be done reliably shows contents varying from 3 to 16 dwt. over widths from 30 to 130 inches. It is intended to continue sinking at two shafts in the hope that the lode will be less faulted and broken at depth.

INDIA.—We refer elsewhere to the flotation of the Jibutil Gold Mines of Anantapur. The latest news of its parent company, the Nundydroog, shows that at the 2600 ft. and 2750 ft. levels in Kennedy's section several points are developing ore carrying from 1 to $2\frac{1}{2}$ oz. over widths of $1\frac{1}{2}$ to $2\frac{1}{2}$ feet. This mine has fully maintained the improvement that has been a conspicuous feature of the Kolar goldfield during the last year or two. On the other hand the developments at the Ooregum continue to be rather disappointing, as the lodes, though containing one ounce ore, are only from six to nine inches wide.

AUSTRALASIA.—A good rainfall is reported at Kalgoorlie. The Bullfinch wild-cats are making a miserable showing. The Yuanmi shaft has cut the vein at 340 feet, disclosing 6 feet of ore assaying 13 dwt. per ton. Good news continues to come from the deep workings of the Great Fingall. Mount Lyell is facing labour troubles, owing to the demands of the engine-drivers. It is likely that the Hercules and Primrose mining companies at Mount Read in Tasmania will be amalgamated with the Tasmanian Smelting Co. of Zeehan. Mr. E. A. Weinberg is promoting the scheme. The strike announced from the British Broken Hill Proprietary is important, if confirmed by actual development work. The drill-holes have pierced an orebody parallel to the main lode, but the shape of it is yet to be ascertained, the distance between the outside bores being 500 feet. The width of ore disclosed is magnificent, but it may prove a flat lens.

MEXICO.—Our correspondent sends an interesting letter. The town of Zapotlan was partly destroyed by an earthquake on June 7. Order is being generally restored after the revolution. The chief event of the month relates to the Camp Bird company, which proposes to issue preference shares in lieu of the existing debentures. This is a wise move. The latest estimates give £71,720 as the profit remaining in the old Camp Bird mine, in Colorado, and £1,793,000 in the Santa Gertrudis, at Pachuca. This includes the ore 100 ft. below the 18th level. Earnings from the Santa Gertrudis are expected to be £245,900 for the first year and £368,852 for the second.

UNITED STATES.—The talk of a copper merger has quieted. In face of recent decisions of the Supreme Court it would be dangerous to promote any combination to control the price of the metal; and unless that were done by curtailing production, what good would a merger do? Sixteen American copper companies, including those operating in South America, plan to increase their aggregate output by about 150,000 tons per annum.

We publish an abstract of the Utah Copper Co.'s annual report. Good news comes from Jarbidge, one of the new gold-mining districts of Nevada.

The Tomboy Gold Mines Co. has issued a circular announcing the acquisition of the Revenue Tunnel mines, which have been inspected by the manager, Mr. D. A. Herron, whose favourable opinion was confirmed by Messrs. P. L. Foster and R. M. Raymond. A sum of $400,000 is to be paid for mining claims having an ore reserve estimated at 137,914 tons, of a gross value of $1,036,297, leaving a net profit of $415,000. This is good business, and does credit to the Exploration Company.

CANADA. — The prosperity of the Mond Nickel Co., which produces nickel and copper sulphate from Sudbury ores, continues unabated. Owing to the demand for nickel the directors are about to erect a new smelter, and for this purpose have offered £250,000 5% debentures for subscription. It will be remembered that when the company started 11 years ago the refining process gave much trouble, but since the process was perfected the profits have gradually increased until during the last financial year the ordinary shareholders received 16¼%. The debentures were readily absorbed.

Porcupine can now be reached by rail. Many speculators are likely to avail themselves of the opportunity. Interest in the goldfield continues unabated. It is stated that the block of Hollinger shares, namely 44,000, acquired by the Northern Ontario Exploration Co., has been sold in New York and Toronto. As these shares were bought at $5 and were sold between $10 and $15, up to $16·15, the company must have made a handsome profit, about $350,000. Also a block of 30,000 shares held by a brokerage house in London has been sold. This accounts for the drop to $13·75 or £2. 17s. London did well on Hollingers. Meanwhile the shares of the Porcupine Development Co., the subsidiary of the Northern Ontario Co., are being offered for sale in Canada. At Toronto and Montreal the wild-cats seem more in favour with speculators than the real mines, whose shares are so high now as to discount favourable developments. Another fire, this time on the Dome Extension claims, has caused the death of 15 men. Rich ore has been found in the North Dome shaft at a depth of 34 ft., and the same orebody has been cut by a drill at 150 ft., the ore showing free gold. This ground lies between the Foley O'Brien and the Timmins claims.

CORNWALL. — The speeches of Messrs. Francis Allen and Josiah Paull at the South Crofty meeting reported elsewhere in this issue strike a decidedly cheerful note, and we congratulate the chairman, engineer, and shareholders on the thoroughly businesslike manner in which this old tin mine is now managed. It is not often that the manager of a Cornish mine can say that he has enough ore developed to last for three years, and it is seldom that regular quarterly dividends at the rate of 20% per annum are paid by Cornish mines, and at the same time large sums put by as reserve. Of course the mine is financially favoured by the present high price of tin and wolfram, but that does not affect the main point, which is that costs are carefully scrutinized, developments are pushed far ahead of the mill, and mining and concentration operations conducted on modern principles.

We also refer briefly to the re-arrangement of control and management at the Carn Brea & Tincroft. Here the chief 'lord,' Viscount Clifden, is taking a keen and direct interest in the work, and through his influence new blood has been introduced on the technical staff. We believe that Mr. Edward S. King and his assistant, Mr. H. Swan Edgar, will in the course of time raise the mine from its present stagnant condition and put it on a profit-earning basis.

STATISTICS

Stocks of Copper in England and the Continent.
Reported by Henry R. Merton & Co.

	April 29 Tons	May 31. Tons	June 30 Tons
In England	61,563	57,557	55,579
In France	6,080	6,081	5,843
Afloat from Chile	2,925	2,200	1,500
Afloat from Australia	7,500	6,775	7,250
Total	78,068	72,613	70,172
In Rotterdam	7,200	7,250	7,200
In Hamburg (estimated)	9,500	10,500	10,100

American Copper Producers' Association.
In Tons of 2,240 lb.

	Production.	Deliveries Domestic	Deliveries Foreign	Deliveries Total	Stocks at end of month
January 1911	51,650	18,785	23,753	42,538	63,591
February	49,030	22,553	20,139	42,692	69,929
March	58,273	29,500	26,375	55,875	72,325
April	52,716	23,396	27,736	51,132	73,909
May	56,679	28,814	27,669	56,483	74,105
June	55,605	27,525	31,902	59,427	70,283

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
July, 1910	610,664	28,050	638,714	2,713,083
August	623,129	26,140	649,269	2,757,919
September	621,311	25,588	646,899	2,747,853
October	627,445	25,702	653,147	2,774,390
November	617,905	24,686	642,591	2,774,390
December	616,668	24,327	640,995	2,722,775
Totals, 1910	7,228,588	305,532	7,534,120	32,002,912
January 1911	625,862	25,201	651,027	2,765,386
February	585,683	24,965	610,828	2,594,634
March	649,247	26,818	676,065	2,871,740
April	638,421	29,293	667,714	2,836,267
May	658,196	27,755	685,951	2,913,734
June	657,023	27,544	684,567	2,913,734

Cost and Profit on the Rand.

Month.	Tons	Yield per ton	Costs per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
October 1910	1,868,718	28 0	17 9	10 3	952,161
November	1,800,371	28 6	18 0	10 7	951,773
December	1,827,423	28 1	17 9	10 5	952,574
January 1911	1,865,232	28 0	17 11	10 1	930,059
February	1,712,198	28 6	18 3	10 3	874,612
March	1,960,678	27 7	17 11	9 9	949,415
April	1,926,583	27 7	17 6	10 1	971,858
May	2,002,926	27 6	17 10	9 7	956,823
Totals and averages for 1909	20,543,759	28 11	17 1	11 6	11,794,376
Ditto 1910	21,432,541	28 6	17 7	10 6	11,216,105

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31	183,268	8,357	9,991	201,616
February 28	189,434	8,513	9,814	207,761
March 31	193,457	8,493	10,061	212,011
April 30	194,328	8,511	10,272	213,111
May 31	190,392	8,379	10,425	209,196
June 30	186,940	8,212	10,597	205,749

Gold Output of India.

Year 1909	Year 1910	June 1911	1911 to date
£2,083,901	£2,104,858	£177,498	£1,052,322

Production of Gold in Rhodesia.

Month.	1908	1909	1910	1911
	£	£	£	£
January	199,388	204,666	227,511	207,903
February	191,635	192,497	203,888	203,055
March	200,615	202,157	228,385	231,947
April	212,935	222,700	228,213	221,296
May	223,867	225,032	224,888	211,413
June	224,920	217,600	214,709	—
July	228,151	225,234	195,233	—
August	230,792	228,296	191,423	—
September	204,262	213,249	178,950	—
October	205,466	222,653	234,928	—
November	196,668	236,307	240,573	—
December	217,316	233,397	199,500	—
Totals	2,526,007	2,623,788	2,568,201	—

Production of Gold in West Africa.

Month.	1909 Oz.	1909 Value	1910 Oz.	1910 Value	1911 Oz.	1911 Value
		£		£		£
January	22,817	91,112	17,357	70,699	15,903	66,107
February	21,403	86,210	16,976	68,469	15,179	63,081
March	23,186	93,556	17,627	71,954	16,387	67,673
April	21,491	88,071	16,363	67,069	17,237	70,880
May	25,104	100,056	16,590	68,355	24,427	96,409
June	17,340	70,561	17,194	70,988	—	—
July	17,331	70,523	15,564	58,551	—	—
August	17,766	71,614	13,921	57,713	—	—
September	18,125	72,963	11,497	47,746	—	—
October	15,957	65,813	13,341	55,046	—	—
November	17,882	73,824	14,021	57,658	—	—
December	17,570	71,332	15,042	61,737	—	—
	235,972	955,635	185,493	755,985	—	—

Production of Gold in Western Australia.

Month.	Export oz.	Mint oz.	Total oz.	Total value
				£
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
January 1911	17,463	102,035	119,498	507,592
February ,,	22,047	84,991	107,038	454,666
March ,,	12,296	93,267	105,563	448,526
April ,,	20,455	91,791	112,246	476,787
May ,,	22,076	88,952	111,028	471,615
June ,,	10,523	106,464	116,987	497,188

Other Australasian Gold Production

	1909	1910	June 1911	1911 to date
	£	£	£	£
Queensland	1,916,468	1,840,337	145,500	788,810
New South Wales	869,546	803,727	56,376	376,774
New Zealand	2,006,910	1,896,522	96,537	882,130
Victoria	2,897,340	2,432,700	174,432	1,033,706

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
April 18, 1911	199½	£23,624	£118 18 4
May 1, ,,	260	£30,313	£116 11 9
May 15, ,,	218½	£25,714	£117 13 9
May 29, ,,	271½	£31,588	£116 4 9
June 12, ,,	223	£26,403	£119 1 5
June 26, ,,	269½	£31,300	£116 10 —

Exports of Tin and Ore from Straits and Bolivia
Reported by A. Strauss & Co.

	May, 1911 tons	June, 1911 tons	1911 to date tons
Metal from Straits to Europe and America	4290	5,060	25,562
Metallic Content from Bolivia to Europe	1687	2,056	10,673

EDITORIAL

UNDER "Discussion" we publish a protest against the vague wording of advertisements intended to secure the services of technical men for appointments abroad. We do not agree with our correspondent's closing remark, however; obviously a fair contract should involve an equal exchange; therefore salary should be proportioned to the experience and skill required. Companies needing men ought to give adequate information, so that misunderstanding may be avoided.

PORCUPINE is likely to gain by a visit from a thoroughly representative group of operators and engineers. On July 8 the following gentlemen sailed for New York on their way to the new goldfield in Northern Ontario: Messrs. L. Reyersbach, H. F. Marriott, C. Algernon Moreing, W. J. Loring, and G. A. Prentice. There is enough money and brains here represented to run a South American republic. One thing they cannot do, and that is to make a gold mine; but they know how to buy one and they know how to operate it on the most approved technical principles. To go to Canada at this season is a pleasure in itself; we trust that the visit of these gentlemen may prove profitable also.

ACCORDING to *The Economist* the applications for new capital during the first half of the current year reached a total of £117,483,800, as against £118,077,000 during the corresponding period last year, and £121,073,600 in 1909. Last year began with a lusty oil and rubber boom, and the revival of world-wide trade also stimulated speculation. This year conditions have been healthy rather than feverish. The Coronation tended to restrict business in the second quarter; it is not likely that a rush of new issues will mark the third quarter, for the holiday season checks activity, but the last portion of the year ought to be lively.

THE KERN RIVER Oilfields has proved a sorry fiasco, culminating in an angry meeting of shareholders. As far as we can learn the trouble is traceable to two familiar defects in company flotation, namely, over-capitalization and lack of adequate independent technical advice. The Californian owners probably received as much as, if not more than, the oil-lands were worth, but the enterprise was handicapped by the excessive burden imposed upon it by sanguine promoters. The engineers who made the reports are not known to us. Their report was made for the vendor syndicate. The directors themselves appear to be novices in oil exploitation. The prospectus was over-loaded with the names of bankers and brokers. When will the public realize that the success of a mining company depends upon unprejudiced advice and experienced management?

DE BEERS and Premier quotations ought to have risen by reason of the display made on the occasion of the gala performance at the Opera. A mining engineer who was present informs me that his eyes suffered as from snow blindness. The finest showing was made by the Maharajah of Patiala, whose manly breast scintillated in a manner to remind Macaulay's schoolboy of the spoliation of Oude. Another gorgeous person was a Mrs. Vanderbilt who did credit to the splendours of New York's smart set. Indeed the scene was so remarkable that the audience became as interesting to those on the stage as the performers were to the spectators. We are reminded of Cecil Rhodes, who,

when presiding at a De Beers meeting, said that as long as women were vain and men were foolish the shareholders would be assured of dividends from the mines at Kimberley. An enterprise that depends more on human frailty than on the vagaries of lode formation is in an unusually strong position.

ON JUNE 29 the new quarters of the Mining and Metallurgical Club at No. 3 London Wall Buildings were formally opened by a luncheon, which was well attended and well served. In the unavoidable absence of the president, Mr. Sidney Farrar, the chair was taken by the vice-president, Mr. Walter McDermott, who made an appropriate speech, not without humorous reference to the 'deep-level' of the rooms in which members can now satisfy the needs of nourishment. Mining engineers naturally try to get 'on the ground-floor' in such financial dealings as the niceties of professional propriety permit, and if they find themselves advantageously placed on the sub-ground floor, so much the better. Undoubtedly they like it. And the members of the Club also congratulate themselves on their secretary. This was shown by the hearty applause that greeted the presentation of a cigarette case to Mr. Charles McDermid, from the committee, the members of which have good reason to appreciate the invaluable assistance given by him in the organization and establishment of the Club. To Mr. Farrar and to Mr. McDermid the most cordial appreciation is due, and is willingly accorded. They can feel proud of the results achieved. The Mining and Metallurgical Club is now a pleasant fact and we hope it may prosper exceedingly.

WE FEEL SORRY for the gentlemen on the staff of the Kyshtim Corporation if, as we are reliably informed, they were guilty of gross inhospitality to three engineers who came on a visit to their mine and smelter. The story is that some of the Kyshtim people had visited the Syssert estate, where they had been well received both as regards technical information and creature comforts. On receipt of several invitations the three gentlemen from the Syssert went to the Kyshtim where they got a greeting something in this wise: "Glad to see you, but your train starts soon; here's your hat." This necessitated a return journey of 80 miles by sleigh within 24 hours and in a temperature of −40° F. Several weeks later it transpired that the directors of the Kyshtim had issued an order prohibiting entry into the smelter or access to the stopes. We thought the Kyshtim was a fine mining enterprise, cleverly financed, well managed, and in the hands of first-rate technical men. What is there to hide?

RECENT FLOTATIONS include the Jibutil Gold Mines of Anantapur (in Madras), a subsidiary of the Nundydroog company and under the direction of John Taylor & Sons. Reports by experienced managers of Indian gold mines are furnished, and reasonable conditions of purchase appear to have been arranged. Preliminary mining work indicates that the prospects justify operations on a larger scale. This is a creditable bit of mining business. On the same day the prospectus of the Mawchi Tin and Wolfram Mines made its appearance. This is a subsidiary of the Southern Shan States Syndicate, which is represented on the board of directors by Messrs. R. Phipps Hornby and P. Wigham Richardson. Participation by the Hirsch Syndicate and the Consolidated Gold Fields of South Africa is indicated by the directorships allotted to Messrs. F. W. Baker and H. D. Boyle, respectively. The board is strengthened by the addition of a mining engineer in the person of Mr. R. Gilman Brown, who will be of great help to his co-directors. An excellent report by Mr. H. L. Twite constitutes the basis of the flotation. Several veins containing tin oxide and wolfram have been tested and sampled

sufficiently to justify further developments, with anticipation of profitable operations. The only criticism we care to make relates to the manner of raising capital; this is done by means of debentures. While convenient, it is not a method suitable to mining, the essential basis of which is a fluctuating asset. Debentures are more appropriate to investments of a less speculative character, such as possess assets having a realizable value in case of foreclosure. In short, debentures are little suited to the ups and downs of mining speculation.

Rand Economics.

The financial supplement of *The Times* recently has contained a series of articles on the mining industry of the Witwatersrand, viewing the subject as it appeals to the British shareholder. Such articles in a newspaper that, despite its recent changes, is still the leader of the world's Press, are sure to be interesting to those engaged in mining. They also provoke our criticism, for a daily newspaper rarely touches a subject so technical as mining without making palpable errors, which have the merit, at least, of putting in print the mistaken notions current among persons who speculate in mining shares. The articles in *The Times* are, of course, excellent in tone and manner; they appear to have been written by one who is familiar with recent writings on the subject, but they indicate the amateur in mining. Thus the first paragraph begins with an elementary fallacy: "The question of the lodes giving out, which is the bogey of most mining concerns, does not exist for the Witwatersrand, for, though the ore of the reef varies in value, there is no doubt that it exists in payable grades and in large quantities down to any depth at which it may be practicable to mine it." Here we have one of the suppositions that has vitiated Rand finance and deluded thousand of shareholders. Our technical readers know and our non-technical readers may be informed categorically, first, that all lodes of gold-bearing ore become poor in depth, and, second, that the skill of man suffices to penetrate the earth deeper than any ore as yet discovered. A lode is "practicable to mine" as long as it continues rich enough to yield a profit; the limit to mining on the Rand is already recognized, the ore becoming poorer in depth until a horizon is reached at which the yield will not suffice to pay the cost, which includes not only the bare expense of extraction but also interest on the capital involved, more particularly during the many years consumed in sinking shafts, building mills, and other necessary preparations. It is true that "the reef," that is, the beds of conglomerate containing gold, does persist to a great depth, but this fact has no economic significance if the proportion of gold is too small to defray all the cost. There is gold in sea-water; that does not make the ocean a mine. On the other hand it is a fact that the ore of the Main Reef series has been found to be subject to variations, irregularities, and breaks comparable to those of veins elsewhere and it is now known that the supposed abnormal uniformity of the banket is a delusion and a snare. The unusual size of the properties, and the enormous scale on which they are operated, has tended to obscure the local variations and the sporadic distribution of the gold. It may be allowed that, taken as a whole, the Rand possesses ore deposits of an extent and homogeneity unknown in other regions, but it is fair to add that these characteristics have been exaggerated to an assumption of uniformity highly prejudicial to sound economics.

When the writer in *The Times* proceeds to explain "why investors are shy" of the Kaffir market, he is well within his own province. It is due, he says, to the fact that "the management of the mines is in the hands of persons who are known to speculate largely in their shares, and in fact, to rely on that speculation as a principal means of livelihood." He refers

to the 'group' control. But he only touches the fringe of the matter, evidently realizing that he is on dangerous ground. We are frank to say that he would have done better service by elucidating this problem than by dabbling in technical affairs beyond his ken. For here is the crux. The mining companies of the Rand are controlled by six or seven groups of capitalists who direct the financial and the technical operation of about 75 different mines. Each group has its own holding company and deals in shares for profit. The difficulty is to reconcile the interest of the holding company with that of shareholders in the various mining companies operating under the control of the former. Again, the holding company may be directed by a firm or by an inner clique of clever capitalists. Can divergent interests be so considered as to give the average shareholder a fair run for his money, especially in the subordinate companies, the shares of which afford the holding company every chance for well-informed speculation ? In the main it is recognized that honesty is the best policy and an effort has been made to give each holding company a reputation for fair dealing. Some lapses are recorded and public confidence has suffered, but, having regard to the power willingly given by speculators to the 'groups,' it is only fair to admit that opportunities for chicanery have been rarely accepted. After all, the public knows how the mines are controlled and they know that the holding companies buy and sell shares in various mines; if then, they disapprove of the system, they should not participate in the dealings resulting from it. We confess that for the moment we see no alternative to the 'group' system, which resulted from the necessity for providing enormous slices of capital for the development and equipment of the mines in the Transvaal. Naturally those who found the money, and assumed the first risk, also expected the control of the business. It was to their interest subsequently to diminish that risk, while retaining full control, by selling shares, at a profit, to the public. In some cases the transaction failed to be sound business, in that it was not mutually profitable, but, on the whole, it is to the recklessness and greed of the public rather than to any deception on the part of the controllers that we must debit the disappointments incidental to speculation in Rand shares.

Of the three articles in *The Times*, the last two and a part of the first are devoted to the labour problem, indicating that the writer has a correct idea of the relative importance of this aspect of his enquiry. Undoubtedly the working of lower grade ore on an extending scale was based on the supposition that greater tonnage would yield not only lower cost, which is secondary, but a larger profit, which is the primary purpose of mining. Moreover a lowering of the average grade tended to obscure the slow but decisive impoverishment in depth and it was a policy calculated to lengthen the lives of the mines. In every way it was a correct policy. But it assumed a practically unlimited supply of labour. This has not been forthcoming. Despite widespread recruiting and higher wages, it has been found impossible to obtain all the natives required. Even the average efficiency has been lowered by indiscriminate recruiting. Competition for labour threatens to create another difficulty. Some mines have been compelled to close-down, but new ones are starting and several big properties are in process of preparation for operations that will demand large numbers of workmen. The writer of *The Times* says that " the controlling houses have as yet shown no sign that they are alive to the situation. Possibly the public sees further ahead, and its realization of what must be considered an inherent weakness in the situation has combined with its distrust of the 'controls' to produce the present unpopularity of the Kaffir market." Of course, the 'houses' are deeply aware of the facts and equally of course the public sees

them only as through a glass darkly. It needs no subtle guessing to conclude that the increasing tendency toward consolidation of properties is, in part, due to a recognition of the necessities of the situation. If the supply of labour be inadequate for all the mines, obviously it were better to work those that are most profitable. When the latter are exhausted and the labour supply becomes superabundant, it will be economical to exploit the poorer mines on a scale even bigger than any contemplated at present. Let amalgamation proceed until the less profitable mines are amalgamated out of existence, to be treated as a deferred reserve for realization when conditions warrant.

Great Fingall.

The annual meeting of the Great Fingall Consolidated was rendered noteworthy by good news concerning recent developments. Mr. C. Algernon Moreing, the chairman, gave a lucid account of the later history of the mine and the manner in which a good prospect has been found in the deeper workings after passing through a poor zone. This affords an excellent example of intelligent exploration guided by geological evidence. The engineers of Bewick, Moreing & Co. had started the work and carried it to the point of fulfilment when Mr. Malcolm Maclaren was engaged to make a geological investigation. His report, dated October 22, 1910, endorses the policy of the management and gives scientific data for the belief that deeper search for fresh ore-bearing ground is justified. It will be remembered that the last of the big stopes in the Great Fingall was on the 11th level (at 1174 feet), but some ore has been mined down to the 14th level. Below that came a decided barren zone. From the 13th level a winze was sunk on the footwall, this usual practice being rendered additionally advisable by the crumbly nature of the hanging wall. Just above the 16th level a wedge of white quartz began to appear, increasing in width until the winze was wholly within it. This white quartz was no good. On opening out at the 17th level (at 2332 feet) some dark quartz containing visible gold was cut on the hanging-wall side. It was 6 feet wide and rich. Then a drift was extended north and south, exposing similar dark quartz for a distance of 337 feet, with 14 dwt. ore in the north face. The winze is now being sunk below the 18th level (at 2492 feet), where a drift has been started northward in ore. This evidence does not indicate a new mine, as yet, but most assuredly it encourages further exploration and justifies the energetic policy of the management. According to Mr. Maclaren the Great Fingall vein is gold-bearing only where it crosses a wide dike of quartz-dolerite, which is 1200 feet wide. This is a striking proof of the relation between ore deposition and petrography. Since the dike dips northwest the ore-shoot pitches at an angle made by the crossing of two planes, that of the vein and that of the dike. This is in accord with observation in other regions. The Fingall vein carries two kinds of quartz, a dark variety, which owes its hue to "loss of light by total reflection from internal strain surfaces" and a white quartz of the ordinary type. The latter is younger than the former and was deposited during a renewal of the fracture marking the line of the present lode. More important is the fact that only the dark quartz is rich enough to constitute profitable ore; the white quartz is uniformly barren. The reappearance of the dark quartz is therefore deeply significant. It reminds Mr. Maclaren of the conditions on the Champion Reef, in India, where the lode, after passage through a poor zone, became as rich at 4000 feet as it was at surface. We hope the analogy thus assumed may be fully confirmed by the logic of events, and that consequently the shareholders may have the gratification of seeing this well-managed mine recover some of its pristine glory.

Smelter Smoke.

In this issue we publish a description of the Casapalca smelter in Peru; incidentally, our readers will find an illustration showing how smelter smoke, when no effort is made to condense and filter it, will pervade the surrounding atmosphere, producing pestilential conditions. We draw attention to this example of unrestrained smoke-production in order to suggest the reasons why smelting works in America and elsewhere have suffered from unpopularity sufficient to facilitate unjust attack and even blackmailing litigation. What Casapalca is today, Butte was a few years ago. We remember when heap-roasting made the Silver Bow valley a veritable Gehenna and when a visitor to Butte found his way amid a noisome murk by following the cough of the man preceding. The utter disregard for the comfort of the surrounding community, even the injury to the health of man and beast, that marked early smelting operations in Western America was followed by an attempt to outlaw a necessary part of the mining industry. Owing to the undoubted nuisance created by the reckless emission of arsenical and sulphurous fumes by one or two smelters, it was not difficult for farmers, and other designing persons posing as farmers, to use public opinion as a lever for applying the restrictive decisions of local courts against all roasting operations. By injunctions and other legal weapons it became possible to hamper smelting and even to put a stop to it. Thus the Guggenheims in 1906 had to abandon the erection of a copper smelter near San Francisco; thus the Selby smelter has been harassed and the old Mountain Copper plant at Keswick was forced into idleness. These are all in California. A similar campaign in Utah resulted in the shutting-down of three smelters in the Salt Lake valley. The two copper smelters in Tennessee were compelled to mend their ways and finally erected sulphuric acid plants from which they now draw a profit. But the biggest legal fight was that waged for six years between the Anaconda smelter and the farmers of the Deer Lodge valley in Montana. This finally was ended in March by a decision of the Court of Appeals, which affirmed the refusal of the lower court to grant an injunction that would have entailed the cessation of the smelting operations constituting an essential part of the mining industry of the great copper district of Butte. In this case the conflicting interests were well represented, and the result appears not only to interpret the law correctly but also to vindicate those fundamental principles of justice that are sometimes outraged by legalities. The facts are as follows: A smelter was built at Anaconda in 1884; this plant was not provided with proper flues and dust-chambers, so that the smoke did escape freely and did cause injury to the neighbouring ranches. In 1895 the old smelter was abandoned and operations were transferred to a new and larger plant in the same locality, but in this case also no special care was taken to abate the nuisance due to the emission of arsenical and sulphurous fumes. Appreciating the necessity for saving the dust, condensing the fumes, and avoiding irritation to the neighbouring agricultural and pastoral interests, the smelting company remodelled its plant, built a high stack, and made scientific provision for preventing the undiluted distribution of the arsenic and sulphur liberated from the copper ore. Just at this time, when the company had finally awakened to its civic duty, the farmers in the valley took steps to harass the smelter people, alleging the injury done in previous years. Thus the two parties were at cross purposes; one of them, awake to the public disfavour into which the other had fallen, tried to levy blackmail; and the other, at the moment when it had realized its responsibility, was subjected to attack by reason of its earlier sins of omission and

commission. The Anaconda company caused an investigation to be made and actually paid $330,000 in settlement of claims. At the same time expense was incurred freely in efforts to determine means for arresting a part of the noxious gases and for diluting the remainder so that it also might be rendered harmless. This led to the construction of larger flues and dust-chambers, and the erection of a high chimney on an adjoining hill. The work was done on a large scale and lavishly, and represents a really earnest and scientific effort to meet the necessities of the case. This was the view taken by the Court, which found that the sulphur left in the smelter smoke had caused no damage to the complainants' crops since the remodelling of the plant in 1903, but that the arsenic was still being deposited so as to do some injury to the fodder and to sicken some of the live-stock in the Deer Lodge valley, and that so long as the smelter was operated such damage would continue to be done. On the other hand no other process of smelting was practicable, no site in Montana could be selected where operations would be conducted with less damage or inconvenience; that if the smelter were to close, two-thirds of the mining at Butte would stop; that incomparable injury would be done to the farmers, and others, by the loss of a market for the products of their land; and that the damage thereby sustained would be greatly in excess of that due to the smoke from the smelter. Here justice wide-eyed and serene must have smiled good-naturedly. Thus ended a litigation that cost at least £150,000, that employed experts not only in metallurgy and mineralogy, but in anatomy and botany, bacteriology and zoology. The testimony covered 2500 type-written pages. But it was worth while; for it established the legal principles involved in such cases and furnished a warning alike to unreasonable farmers and to careless smelters. Anti-social conduct from either is not tolerated by the law, which in such cases defends the greatest good of the greatest number. The organizers of smelters will be wise in refraining from building furnaces in agricultural districts; the farmer is warned not to attempt to establish himself where metallurgical operations are necessary to the existence of an industrial community.

The Giesecke Mill.

Keen interest has been aroused by various statements emanating from Johannesburg concerning the good work done by a new crushing machine, the Giesecke tube-mill. It appears that this mechanical device has been undergoing a test at the Geldenhuis Estate mill under the auspices of the Mines Trials Committee, a body of technical men appointed by the various groups acting conjointly. Attention was drawn to the subject by Mr. A. Brakhan, who, in presiding at the annual meeting of A. Goerz & Co., on May 26, at Johannesburg, said that a rotary mill, intended to replace the existing stamps and tube-mills, was undergoing successful trial. Next day, Mr. Lionel Phillips, at the banquet of the South African Association of Engineers, mentioned the matter, saying that it would greatly influence the development of the gold mining industry; it would mean the final elimination of amalgamating plates and the passage of ore direct to the cyanide annex; it would dispense with stamps and would result in a great diminution of capital cost. Since then a visit of inspection has been made by many of the technical men resident on the Rand and the general opinion is that the Giesecke tube-mill represents an interesting and suggestive departure from established practice. But it is too early for positive opinions. The present test is being directed mainly toward ascertaining the efficiency of the machine as a composite grinder. It is a ball-mill with a tube-mill attachment, or it can be described as a ball-mill and a tube-mill in tandem. The

total length is 24 feet, of which about one quarter has a diameter of 7½ feet, while the remainder is slightly less than 6 feet. The ore, which is coarser than that ordinarily delivered to the stamp battery, is fed by an Archimedean screw into the machine, where steel balls fall upon steel liners made from plates 2 inches thick, 12 inches wide, and 24 inches long. These are bolted at one end and fixed to a strong spring at the other. This cushioning prevents excessive wear of metal on metal. Eight sizes of steel spheres are employed; these vary from 4 inches to 1¼ inches in diameter, the biggest being placed in the larger chamber, where the ore is first broken before passing, through a diaphragm, into the smaller cylinder. The wear and tear is compensated by adding balls of the larger size. As the ore enters it is sprayed with water; this represents only 28·5% by weight of the material pulverized, but it is enough to form an emulsion, which before being discharged passes through a mixer, an elliptical chamber fitted with steel arms. The pulp is comminuted to a remarkable degree of uniformity, for one screen analysis showed that 86% passed 200 mesh. The mill at the Geldenhuis Estate is said to crush 360 tons per day, using 230 to 240 horse-power. The total weight of the machine is 68 tons, of which 23 represents the steel balls, 16½ tons the liners, and 15¾ tons the tube itself, the remaining weight being apportioned among driving gear and supports. The underlying purpose is to diminish the proportion of water, thereby augmenting the grinding efficiency; also it is intended to treat the ore in one process, instead of crushing first in the stamp-battery and then pulverizing in a tube-mill. The Giesecke mill is said to receive the ore in sizes up to 7-inch cube, but our Johannesburg correspondent, who is usually well informed, states that the material delivered to the machine is "of a size fit for stamp-milling," which we interpret as meaning that it would pass a 2½ inch ring. On its passage through the Giesecke tube-mill the ore has been reduced to a pulp 80% of which, at least, will pass a 200-mesh screen; in other words, it slimes the ore in one operation. At the Geldenhuis Estate one of these mills is taking the material previously treated by 50 stamps, which, although of lighter pattern than is customary nowadays, would crush about 300 tons per day. Again, a plant of 50 stamps, with tube-mills in proportion, would cost when erected at Johannesburg about £20,000, while the Giesecke is quoted at £6000, to which in both cases must be added the cost of motive power. No precise comparison can be made, but even the preliminary estimates indicate that the use of the new machine, if it does as reported, would permit an enormous reduction in capital outlay. It remains to know the cost of maintenance, that is, of repairs and replacements incidental to wear and tear. The frictional work done in grinding 350 tons to a powder cannot be insignificant; the abrasion of steel, in balls and liners, is likely to be a serious item of expense. Of course, in the ideal tube-mill the hard lumps of ore grind the softer particles, but the operation assumes that the harder lumps are themselves pulverized within a reasonable interval. A minimum use of water tends toward a maximum crushing efficiency; this feature is excellent, but on the other hand the absence of any classifying operation between the beginning and the end of the composite grinding process may allow some particles of pyrite, encasing the gold, to pass with the pulp without being re-ground. Thus the one-stage machine may lack advantages afforded by a two-stage process. The quartz, the pyrite, and the cement, which binds the quartz pebbles of the banket, represent three diverse constituents of the ore, and yet all three undergo exactly the same process of reduction in the Giesecke mill. Obviously there are points on which fuller technical informa-

tion is requisite. One optimist says that by the use of this machine the cost of treating ore on the Rand may be reduced to two shillings, equal to half a pennyweight of gold, per ton. We may remind our readers that the operating cost of mill treatment on the Rand averages 6 shillings per ton, but this figure does not include allowance for amortization of capital expended in milling equipment. Here is the weak feature of Rand economics. The average shareholder overlooks the fact that "cost" at the last resort includes redemption of capital and interest upon it until redeemed. However, we welcome the Giesecke tube-mill as we welcome any new device that may fulfil one of two functions, or even both of them, namely, to stimulate mechanical ingenuity in gold metallurgy on the one hand, and to increase the profit of mining on the other. The first conduces eventually, if not at once, to the second.

Prestea.

West African mining has been subjected to so many disappointments, in part due to climatic conditions and in part to the patchiness of the lodes, that it is a relief to read the report of the Prestea Block A meeting. The chairman, Mr. Edmund Davis, was able to give a most cheerful and satisfactory statement. It is true more capital is required, increasing the obligation under which the mine is operated, but the addition seems to be fully warranted and has been secured on terms indicating the good credit of the enterprise. The Prestea is undoubtedly one of the finest gold lodes ever uncovered by the prospector; it is a quartz vein of remarkable uniformity traversing schist; the orebody itself has been proved for over 7000 feet in length and will probably average 8 feet wide of 11 dwt. ore. As far as it has been tested this orebody is persistent and appears likely to extend to a great depth. On the No. 6 level, at 630 feet, which is the deepest, an excellent showing appears, the drifts north and south having been extended for 1000 feet in ore averaging 7 feet in width and 14 dwt. by assay. At the end of 1910 the reserve consisted of 678,000 tons, averaging 43'9s. per ton, and on May 31, 1911, this had been increased to 879,000 tons of 43'2s. ore, representing £1,490,095. Of this amount only £500,000 is likely to be available for dividends, for the operating cost is officially estimated at 20s. and extra expenses will consume fully 3s. more. It is not likely that the total cost will be under 25 shillings. The present market valuation of the mine, at 30s. per share, represents £1,275,000. Therefore the profit assured is not quite 40% on the present share-value. Mr. Davis gave £20,000 to £25,000 as a forecast of the monthly profit. Taking this as £250,000 per annum actually available for dividends, the yield to those who buy on the present valuation would be about 20%. At 30s. per share the Prestea is a lively speculation, although it cannot be termed reckless, having regard to the promising showing at the bottom of the mine. At present 60 stamps have been erected and 40 are at work. By the end of the year the full complement of 110 stamps is expected to be available, but shareholders had better allow for delays, incidental to all new plants, especially in West Africa.

The report makes reference to sanitary arrangements and to the supply of fresh meat to employees. Mr. E. A. Ridsdale, a director, in his speech mentioned these matters. They are quite as important as the assay-value of the ore. Without efficient labour and cheerful co-operation, the winning of the gold is made needlessly expensive. Directors of mining companies on the Gold Coast should realize as business men, let alone humanitarians, that the labourer is a machine the efficiency of which depends on his physical well-being. A notable change for the better is evident of late in this regard. Mr. Walter Broadbridge, the engineer who laid out the present scheme

of operations at the Prestea, and is responsible for the existing reduction plant, during the time he was connected with the company had always in view the importance of improving the living conditions and introduced many improvements in sanitation and food-supply.

Engineers as Financiers.

In one of the earlier issues of this Magazine we raised objection to the suggestion that young men about to become mining engineers should start their career with the idea of participating in the promotion and other financial aspects of the mining business. This has been interpreted in some quarters as a desire to discourage any technical man from taking part in financial affairs connected with the exploitation of mines. As a misunderstanding appears to have arisen and as the subject is one of vital interest we shall discuss it once more, it being always understood that is not our function so much to codify practice as to encourage the formation of a healthy public opinion on this and other matters appertaining to mining. Mining is a business based upon the application of science to labour; when thus organized it becomes an industry, whose underlying purpose is to make money. Technical science is applied to mining with a view to profit; without profit a mine becomes a mere hole in the ground; therefore an engineer who cannot direct operations so that they yield dividends is a failure. The engineer must keep an eye on the pounds, shillings, and pence; if he does not, he is an idle dreamer or an impracticable theorist. Hence the successful mining engineer must be a keen business man, combining a knowledge of technology with an appreciation of finance; but this does not mean that he must be a financier. Here we begin to part company with some of our friends. To express that divergence, we shall employ a homely simile: A father does not advise a mere boy to drink whisky and soda; he is perfectly aware that in the course of time the boy will become a young man and will acquire the habit, by no means injurious when followed temperately. If a youngster takes to the stimulant when unnecessary it is apt to lead to excesses; acquired too soon, the habit will ruin his stomach. Thus it is with financial participation on the part of the young engineer. As he gains in experience and becomes concerned with large mining enterprises, he is bound to take as keen an interest in the machinery of finance as in that of the mill or smelter; inevitably also, especially if his mind has a bent that way, he will participate, and in some cases direct the monetary operations. But should he do this prematurely he will develop tendencies checking his natural development as a technologist. The apprentice who is learning his profession is corrupted by participating in promotions and the like at the time when he should be giving his undivided energies to the fulfilment of his duty as a technical man; until he has won his spurs and gained discretion it is well for him to keep his eye on the ball, neither slicing a commission nor pulling a promotion. The average youngster that dabbles in stocks and shares, in commissions and promotions, in early life is unlikely ever to learn engineering thoroughly; if, on the other hand, he postpones taking a hand in the most tricky and most difficult part of the business until he has gained some of the experience of living and learning, he may hope to play his part usefully to himself and others. Again, we hold that it is not well for a man to take the rôle of a financier when he is without adequate responsibility; we deprecate such financing on the edge of a razor as gives no hostage for good conduct. The schemer who risks other people's money in order that he may make a big gain is not a financier; he is an irresponsible adventurer. Such men play a lone hand and are dangerous to the community. Therefore financial participation on the part of an engineer is only commendable when he gives bonds, as it were, that is, has money

enough of his own to make him properly cautious. This applies to older as well as younger men, but as the acquisition of capital is a matter of time it applies more directly to the younger. We speak of the average man. It so happens that some young engineers of quite exceptional business capacity have developed as successful financiers at an early age and it has been assumed that what they have done, others can do. This we disbelieve. Others have tried to do it and have suffered shipwreck. We speak with a wide acquaintance with our profession and do not hesitate to say that the premature development of a taste for financial speculation has ruined more young engineers than wine, women, and song. We take life as we see it. Theoretically a man ought to be able to dabble in the waters of the Stock Exchange without drowning; academically, he ought to hold a financial interest without vitiating his judgment; practically, he rarely does either one or the other.

Platinum & Gold Concessions.

A few days after our June issue went to press the prospectus was issued of the Platinum & Gold Concessions of Colombia. This is an example of ill regulated energy as applied to mining. The company is formed to exploit placers in the department of Cauca, Colombia. As evidence of probable success the opinion is given of a native gentleman who is Intendant of Choco, and this is followed by extracts from sundry writings of an wholly inconclusive character. No real report by an engineer is vouchsafed, although one of the directors is an Associate of the Institution of Mining and Metallurgy. He, at least, ought to know—if his fellow directors do not—that the technical data are worthless as evidence of a profitable enterprise. The only simulacrum of a report states that the writer of it "cannot tell the number of tons of mineral therein [referring to the concessions] contained, because this would be a question of calculation." From which it might be inferred, erroneously, that the data for an estimate exist, but that the gentleman's early teaching in arithmetic was faulty. The putative shareholder is told concerning the concession that "its richness is well known and acknowledged in various publications written by eminent men." This is hardly good enough even for a financial gambol! Much the same might be said of the gravel of the river Colchis, of the Ethiopean hinterland, of Greensland's icy mountains and India's coral strand. Indeed the proof of economic value is too absurd. This is not business, but farce. After the Intendant of Choco comes a quotation from the writings of the late R. B. White, known to us as a fair geologist and railroad engineer, but constitutionally too optimistic to be regarded as a trustworthy appraiser of mines. For instance, in 1886 he made a glowing report on the La Plata mine in Tolima and it required John C. F. Randolph's good sense to correct a wholly erroneous estimate of a mine that never passed beyond the prospecting stage and was long ago abandoned as worthless. Of course, it is well known that gold and platinum are to be found in the gravel of the Choco and they have been extracted in a desultory way for centuries by nomadic *mazamorreros* or gold washers, with *cacho*, *zambullidora*, or the ordinary *batea*, as a means of concentration by hand. But the region has not been either tested or explored by the modern methods of boring and shaft-sinking; in short, it remains to be proved whether the deposits can be exploited profitably on a large scale. On this point the prospectus says nothing, although the Intendant's estimate of 15 grammes of platinum and gold per ton is employed as a basis for the calculation that with a daily output of 150 tons the profit would be £47,000 per annum. Plainly, the scanty evidence might warrant systematic prospecting but it does not justify an appeal to the public in the manner of the prospectus.

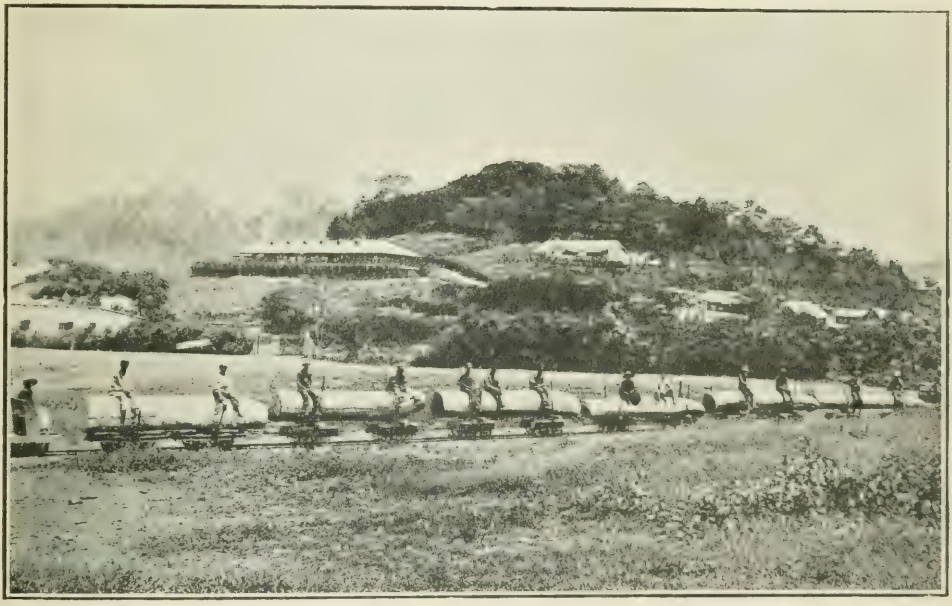
SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

TAQUAH.

Railway Vagaries.—Mine-Managers in West Africa are frequently wroth at the peculiar manner in which railway matters are conducted, and the experience of the manager of Quaw Badoo forms a good example. He wished to rail a second-hand locomotive-type boiler from Prestea to a point about 100 yards from the Ankobra bridge, a total distance of probably $1\frac{1}{4}$ miles. The weight was stated at 10 tons, but there is no Government weigh-bridge at Prestea and the Traffic Inspector (a white man) said the truck containing the boiler would have to be sent to Taquah to be weighed. Rather than have any delay the mine-manager offered to pay for 16 tons, the maximum truck-load, but 'red tape' ordered the lot off to Taquah (a distance of about 20 miles each way) where the nett weight was found to be 9 tons 16 cwt. The Railway Department had all that extra haulage for nothing and lost the freight on 5 tons 4 cwt., and the mine-manager lost nearly a week's work. The railway is paying handsome returns on a most extravagant rate of construction; a little more common sense in administration would make such a saving that freights could easily be reduced.

Prestea.—Another piece of bad luck must be added to the many that have befallen this unfortunate mine. The boiler plant was in a forward state, and the iron chimney, a structure about 140 ft. high by 8 ft. diameter, and about 30 tons weight, was being lifted into place when a derrick canted, throwing the whole weight on to one block, which gave way, so that the chimney fell right across the boiler-house, and the whole of the middle section collapsed as if made of paper. The roof of the boiler-house was badly crushed, but being a steel building it fortunately prevented the chimney from falling on the boilers beneath. The repair of the chimney will cost hundreds of pounds, besides delaying the completion of the boiler-plant.



OBUASI, HEADQUARTERS OF THE ASHANTI GOLDFIELDS.

Forty stamps are at work intermittently, and the first three bars of bullion from the new plant were brought into Taquah this week. You will probably hear of the value before we do. There are 50 stamps erected

and we hear that the duty for the actual working time amounts to 11 tons per stamp per day. It is proposed to erect another 50 stamps, but this addition may be postponed as the present mill can deal with as much ore as can be handled. Owing to the failure of the main supply-pump at the Ankobra river, the water from the mine has been used for milling purposes.

Rainfall.—The May rainfall was unusually heavy, and in consequence most mines have had to contend with an additional influx of water, and those depending on wood fuel will be put to much inconvenience. The greatest trouble will be caused in outside districts among prospecting propositions. June, which is usually the wettest month of the year, is behaving nicely so far, the rainfall for the first 8 days being very light.

Timber Foundations.—The Abbontiakoon new stamp-mill is supposed to be on order, and it is to be hoped that the engineers have given some thought to the material to be used in the foundations. These in most mills in West Africa are usually made of concrete as a base, but in the Wassau mill the mortar-blocks were of imported pitch pine, which speedily rotted, giving much trouble on the last two years running. In other cases, such as the 50-stamp mill of the Taquah mine, the main base was of concrete, on which were laid cast-iron anvil-blocks to receive the mortar-boxes; the longitudinal sills, strake sills, and the mill-posts and ore bins were of wood. The mill started in July 1907, but the ravages of this climate are so severe that the timbers are rapidly decaying, and indeed are now being replaced in connection with 30 stamps. The present manager, wise in his generation, is preparing to use steel girders and reinforced concrete in place of timber, so that when the full 50 stamps resume crushing there should be no further trouble about foundations during the life of the mill. Pine timbers last fairly well in this climate, if they can be kept either quite dry or else completely under water, but as neither of these conditions can be fulfilled in a stamp-mill foundation, other material must be utilized in construction work. Even battery-posts fail quickly if made of wood, while the dampness in the ore is generally sufficient to ensure speedy destruction of a wooden bin. Local timber would be more enduring; Kaku, Kwisaba, and Odum furnish excellent wood, and might give much better results if the trees were 'rung' a year or so before felling, so that the timber could season in an erect position as it stands; but there is no doubt that steel and reinforced concrete will in the end prove most economical. It is found in ore-bins, for example, that pitch pine of 12 by 12 in. section usually rots completely in about 4 years. But is there any reason why the ore-bins both at the 'bank' and in the mill cannot be constructed completely of steel? On all the principal mines the practice, until recently, has been to timber the shafts with 8 by 8 in. pitch pine, a custom which is still followed in some places, but steel setts are now being generally used with great advantage.

TORONTO.

The Bureau of Mines has issued a statement of the output of the metalliferous mines and works of Ontario during the first three months of the year, the total value being $6,808,769. The output of silver was 7,530,487 oz. valued at $3,708,544, as against 6,329,927 oz. of the value of $3,041,156 for the corresponding period of last year. The production of pig iron was 115,454, valued at $1,823,717; an increase of $73,321. Copper and nickel show decreases, the output of the former being 2131 tons, valued at $303,240—a diminution of $53,834—while the production of nickel, 4124 tons, was valued at $884,292, being a decline of $246,032. Porcupine does not figure prominently as yet in the returns, the total output of gold being only 1813 oz. valued at $33,990.

Porcupine.—The laying of the rails on the Porcupine branch of the Temiskaming & Northern Ontario Railway has been completed, and it is announced that the line will be regularly in operation by the beginning of July. An arrangement has been effected under which the road will be extended about five miles farther west, so as to serve the Hollinger and other mines in that part of the district. The Timmins-McMartin syndicate has agreed to finance the extension by advancing about $150,000 to the railway commission. Development work at the Hollinger has been delayed by the bush fire on May 20, which destroyed nearly all the buildings and most of the plant, causing a direct loss of about $125,000. The plant will be renewed as soon as possible on a larger scale, with 60 stamps in place of 30, as at first proposed, and cyanide equipment. It will be difficult to get in the machinery on account of the condition of the roads, and the mill is not likely to be ready to start before August. So much ore is on hand that the company will not be able to do

custom work, as at first proposed. Power from the plant at Sandy Falls on the Mattagami river is in readiness as soon as connections can be made. The workings are 200 ft. deep; at this level 200 ft. of drift has been made on the main vein, which is from 4 to 20 ft. wide. The assays vary greatly, but the high values found at the 100-ft. level have in some instances been duplicated. Owing to favourable reports the Hollinger continues to lead the stock market, and has been latterly advanced in price, being quoted at over $15. The other Porcupine issues have also generally appreciated. Little interest is taken in the Cobalt stocks.

A PORTAGE ON THE WAY TO PORCUPINE.

The Vipond on the 100-ft. level has cut a long high-grade ore-shoot, which has been stripped on the surface for several hundred feet. The main shaft on the Dome Extension has been sunk nearly to the 100-ft. level. As soon as this is reached a cross-cut will be run to tap the main vein, which is about 30 ft. from the shaft. It is 36 ft. wide with four lateral veins carrying high-grade ore on the surface. Pearl Lake, which sustained a loss of about $15,000 by the fire last month, is pushing development work and has recently made some good finds. Two shafts are down about 60 ft. near the two principal orebodies with encouraging results. At the Preston East Dome a number of quartz stringers have been found to unite at the depth of 40 ft. forming a 4-ft. vein showing free gold. The Scottish Ontario has struck free gold in a shaft 18 ft. deep. The No. 1 shaft is down 100 ft. and about 500 ft. of driving and cross-cutting has been done. The Rea vein has been struck at the depth of 200 ft. by a cross-cut 14 ft. from the shaft. It is richer than on the surface and 23 in. wide. The Jupiter lode has been traced by stripping for 350 ft. on the adjoining Booth-Armstrong property, where it has been cut at 83 ft. with a diamond-drill. The Success property, comprising four claims in the township of Tisdale, has been sold to W. Laing Malcolmson, of London, after undergoing a careful examination by H. Brian Pearson, an English engineer. Ralph A. Meyer has been appointed manager and a force of 50 men will be engaged. David Richards, who has been in Canada since February representing the Bewick-Moreing interests, has sailed for England. The Swastika has increased its capital from $1,000,000 to $2,000,000 in order to buy additional claims and erect a new mill.

Cobalt shipments have latterly been well maintained, but, owing to the increased output of bullion and concentrate, the tonnage of ore shows a decrease as compared with last year. The Nipissing intends to sink a shaft on vein No. 64, which has been very produc-

tive, to a depth of 1000 ft. in order to test conditions at that level. The Nova Scotia, which has a cyanide plant in Cobalt, has arranged to treat ore from the Kerr Lake and Crown Reserve mines, and to enable the mill to treat 200 tons daily its capacity will be nearly doubled at a cost of $100,000. The ore will be conveyed to the mill by an aerial tramway 5000 ft. long. The Rochester will sink to the 400-ft. level and work the continuation of the Lumsden vein into the property at the 300-ft. level from the Lumsden mine. The Waldman, in the Gillies Limit, which has been closed down for some time, is resuming operations. Trenching on the surface is being undertaken in the hope of striking other veins. The Beaver has declared an interim dividend of 3%. The Temiskaming will pay its regular quarterly dividend of 3%. The Crown Reserve has declared 2%, with 3% extra. The power-plant of the Nancy Helen has been destroyed by fire, entailing a loss of $16,000. The mine has been closed for some time. The Kerry mine has resumed operations with a large force on the 350-ft. level. The La Rose is opening a third level from the main shaft at 270 ft., the deepest point reached.

The Lake of the Woods district is again attracting attention from capitalists and prospectors. Several old mines have recently been re-opened. The Ontario Government has commissioned A. L. Parsons, lecturer in mineralogy in Toronto University, to make an examination of the district, which was prominent in 1897. The Mikado mine has been re-opened with R. B. Nickerson as superintendent.

Yukon.—The Canadian Government has issued an order in council abolishing the royalty on gold extracted from quartz in the Yukon territory, as a means of encouraging this industry. So far the results of quartz mining in the Yukon have been unsatisfactory and no royalty has been collected.

Diamonds. — The recent discoveries of diamonds in British Columbia have been followed by another find of the same character by R. A. A. Johnston, mineralogist to the Canadian Geological Survey, in the old chromite mines at Black Lake, in Quebec. Officials of the Survey are endeavouring to discover a commercially feasible process for extracting the diamonds from the chromite. With this object in view Mr. Johnston will sail shortly for Germany, taking with him samples of the Canadian diamonds. The largest of these is three-sixteenths of an inch in diameter.

DENVER.

Colorado.—Mining men have long held it as one of their articles of faith that a great camp should be discovered within the State every ten years. Since the second decade has now passed, however, without a discovery comparable to those of Gilpin, the San Juan, Leadville, or Cripple Creek, many prophets have become discouraged, though none apparently have lost faith in the final outcome. Mining men are puzzled and half indignant at the failure of any great new camp to come forward since Cripple Creek electrified the world. Two years ago, in writing of the situation, I spoke of them as waiting Micawber-like for something to 'turn up.' Now they have adopted instead the crowbar philosophy and propose to turn something up. The whole State is discussing means to promote the discovery of a new mining district. Numerous committees have been formed, and a persistent effort is being made to advertise the mineral resources of the State. That new mines have not been opened as rapidly as have new farming districts is clear, and it needs but a casual study of the smelting situation to convince one that mining in Colorado has not kept pace with general development in and outside the State. A variety of reasons have been urged, but it is becoming recognized that it will not suffice to continue to sell holes in the ground to Eastern tourists or simpletons. Mines, not nicely-engraved stock certificates, are needed; to find mines, prospecting is essential. The hills are no longer covered with prospectors, and it is no longer true that every merchant and professional man is contributing to a grub-stake. Many reasons may be cited: the discovery of new veins now requires more skill, time, and money than when rich ore-shoots were still to be found at the surface; more avenues exist for profitable employment of both skill and money than when mining was the only industry. The fact remains, however, that there are large areas in Colorado, geologically favourable to the occurrence of minerals, and these have been but inadequately investigated. One of the Denver newspapers is advertising itself and attracting attention to the State by collecting a 'grub-stake fund' to be administered by a committee consisting of Max Boehmer, James Doyle, and Ernest Le Neve Foster. It is proposed to send out experienced prospectors, including in each party a school-of-mines man and an old prospector. These are to locate claims on anything of value. At intervals the various parties are to be

IN THE HEART OF COLORADO.

visited by a mining engineer, who will advise the men regarding their work, and, if the money is not honestly and intelligently applied, the supply of funds will be stopped. A number of the best known assayers are co-operating with the committee by making free tests, and there would seem to be some hope of success. Another feature of the moment is that support will be furnished to any prospector who is hampered, or thinks himself hampered, by officers of the Forest Service. There has been friction between prospectors and forest-rangers and the matter has been magnified until opponents of the Service lay at its door blame for the whole failure to discover a new district. This is unjust, but the assurance that any real interference with prospecting will be promptly investigated and adjusted, will have a good psychological effect. Whether the new move will result in the discovery of competent prospectors, which is pre-requisite to finding ore, is not certain. So much has been said of chance discovery and so many of the larger mines have been found by inexperienced men, that there is no general recognition of the fact that really careful investigation of any area requires skill and patience. Competent and determined men have generally been able to get a grub-stake. The best hope is that the new movement may attract recruits of the right temperament who may develop real skill. That there are great mines yet to be found in Colorado no one familiar with the State can doubt.

State Aid.—It is perhaps characteristic of the growing American tendency to depend on organized social effort in place of the sturdy individualism that characterized the work of the isolated pioneers that Colorado is now making increasingly liberal appropriations for the investigation of her mineral resources. Large sums have been given to the Agricultural Schools, and it has long been customary here as in other States, to support agricultural experiment-stations. Relatively little has been given to the excellent School of Mines at Golden, and nothing has been spent, till recently, upon experimental work in connection with mining. In the last ten years the Agricultural College has received $1,705,858 and the School of Mines $782,174. Fortunately the tendency now is toward more liberal support for the mining school and also for supplemental investigations. New buildings have been erected and larger appropriations made for teaching and laboratory work. One of the most interesting departures has been the erection of a large ore-testing plant at Golden, at which engineers may carry on tests to determine methods of treatment for any ore. The professors will be available for consultation, and the students, while serving as assistants, will get valuable training under rigorous commercial conditions. A supplemental appropriation of $50,000 has just been made to equip this laboratory. Unfortunately, politics has always entered even into the educational work of Colorado, and now an effort is being made, at the behest of one of the powerful politicians of the State, to force the resignation of Victor C. Alderson, the president of the School of Mines. Mr. Alderson came to Colorado in 1903 from the Armour Institute of Technology. He is a mathematician, a graduate of Harvard, and has done excellent service. These recurrent squabbles have done much to hamper work at Golden; it is to be hoped that a sound public opinion may soon develop and prevent interference with any of Colorado's schools.

Another agency of the State for developing its mineral resources is the Geological Survey, now in charge of R. D. George, of the State University. In the short time since the department was organized, Mr. George has done excellent work, particularly in the study of the tungsten industry in Boulder county and the rejuvenation of mining at Montezuma. It is pleasant to record that the value of this work has just been recognized by a liberal increase in appropriations. It is not so pleasant that at the same time Mr. George is in the hospital as a result of over-work. I am glad to say that no doubt of his recovery is entertained. Unquestionably, he will make excellent use of the money when he is again able to take the field, for Colorado is a mining region that presents an extraordinary diversity of lode-structure and geological conditions.

Legislation relating to mining attracted much attention at Denver this winter and now that the Legislature has adjourned it is possible to take account of results. The proposed changes in mine inspection were not made, the bill, after numerous amendments, having finally failed to become a law. It will be recalled that following the disastrous explosions last fall in the coal mines, conditions were investigated by a commission appointed by the Governor and a new act proposed, designed to greatly increase safety in mines. The cost of the new inspection was to be met by a tonnage tax and in other particulars the plan was so radical as to fail of the necessary popular support. It was, how-

ever, defeated by the devious and familiar method of first loading it with distasteful amendments. Colorado has thus postponed taking a step that is inevitable, although the discussion has greatly enlightened the public. Some changes were made in taxation laws and a means has been provided for forming mine-drainage districts. Whereas it has long been possible in America for farmers to organize to drain their lands and to compel any recalcitrant to pay his due portion of the cost, there has been no similar rule regarding mines. The great Roosevelt adit at Cripple Creek was driven by a company organized as a result of private effort and there was no way to compel any one however much benefited, to contribute to the cost. Now that $50,000 is needed to extend the work it is still necessary to solicit funds as for a public charity. The new law will remedy this condition.

Tunnel engineers are much interested in a bill passed by the Legislature submitting to the people a proposal to issue bonds to the value of $4,000,000 to furnish funds for driving a tunnel through the main range of the Rocky Mountains at Rollinsville. This tunnel was originally projected in connection with the Denver, Northwestern & Pacific railroad, familiarly known as the 'Moffat line' and designed to furnish a short cut directly west from Denver. The railroad company found itself unable to complete the project and it is now proposed to make the bore as a public enterprise, reserving right of way to any railroad having or making the necessary connections. Two surveys call respectively for four and six miles of tunnel. The impression is that the people will vote for the bonds and that the work will be undertaken. In the meantime the Laramie-Poudre tunnel, undertaken in connection with an irrigation project, is nearly completed. In May 635 ft. of driving was accomplished and up to May 25 progress was at a rate of 700 ft. per month. Broken ground was, however, then encountered and slower progress cut down the total. D. W. Brunton, consulting engineer, hopes still to establish the 700 ft. record before completing the work. He already has the American record for hard-rock work. An interesting and valuable paper on tunnel-driving methods was read by W. L. Saunders at the Wilkes-Barre meeting of the American Institute of Mining Engineers early in June. It attracted much attention in Colorado, where many deep drainage adits have been driven in connection with mining.

JOHANNESBURG.

Kimberley Methods.—Ever since Mr. Alpheus Williams read his paper on certain features of Kimberley mining practice, Rand engineers have been at great pains to demonstrate the difficulties and drawbacks to be faced in applying De Beers methods to the Rand. As the paper dealt particularly with the handling of "large quantities of ground in the minimum of time," it is certainly unnecessary to discuss the application of Kimberley methods to mines having no big tonnages to handle; at the same time there seems no reason to demand that main levels, equipped with electrical locomotives or rope-haulage, must necessarily serve such great quantities of rock as in De Beers in order to prove an economical innovation. The tendency of critics, moreover, has been to view the "main haulage" idea too much in the light of normal Rand practice, and too little in its relation to adapted schemes of development, in the big amalgamated areas of today and tomorrow. E. J. Laschinger, the well known Corner House engineer, has reviewed Mr. Williams' paper in a spirit of fair criticism, but his cautious arguments clearly indicate strong bias against "elaborate main haulage systems underground." He remarks: "The time-honoured living-from-hand-to-mouth policy is one that has points in its favour, because it is a gold or ready cash industry. Our gold mines never have a slack time of production, when one can quietly introduce changes and elaborate improvements." It is perhaps a little misleading to accuse the Rand, with its big ore reserves, of following a "hand-to-mouth policy," though Mr. Laschinger's meaning can be easily grasped. The mills have—often with good reason—been fed from many scattered places and the introduction of a policy demanding concentration has been impossible. But must these conditions always prevail? Is the big mining area to remain a mere conglomeration of little units, with amalgamation represented by the erection of a joint office, or are the underground workings to be made to feel the influence of the big tonnages required at a common point? Whether your property is producing 10,000 tons per month or 100,000 tons, your breaking cost will remain unaltered, for it is dangerous to economize in official supervision over a given number of stope-faces and the individual stope efficiencies will be unchanged. Manifestly it is in tramming, hoisting, and pumping that underground economies must be attempted and it is by concentration that it can be done.

Miner's Phthisis.—The Government has done wisely in appointing a commission of medical men, with strong powers, to investigate the question of miner's phthisis, especially in relation to the extent to which the disease prevails. The body comprises Visser, S. V. van Niekerk, R. Daly, E. Baumann, L. G. Irvine, and G. D. Maynard, men who, if not all adequately equipped with a specialist's knowledge of miner's phthisis, will at least arrive at sound decisions. For this we may well be thankful in days when the crank is allowed to assume high status in public influence and when the afflictions of the miner are often exploited for selfish political purposes.

Quality or Quantity.—It was surprising that Dr. Moir, as President of the Chemical Metallurgical and Mining Society, and one of the best scientists in the country, should have found occasion to congratulate the Society upon the record *bulk* of its April journal. It is time that the Society exercised greater discretion in the publication of matter and resorted to a policy of severe selection. The low-grade big tonnage idea can be carried to excess in literary as in mining work. I have already referred to some of the errors and weaknesses in Mr. Schmitt's paper on 'Future Economies in Rand Reduction Plants,' which accounts for 28 pages of the 'record' journal, and there is no need to continue the discussion of the theme. It need only be added, in regard to the question of bulk, that several of the theoretical flow-diagrams could have been omitted, and that there was much superfluous reading matter, based on a multiplicity of minor modifications of a general scheme. These criticisms are made in no carping spirit, for all members of the Society must recognize the excellent work done by the editorial committee in putting together a useful publication and especially in compiling abstracts from current technical literature, with the discretion displayed. It is, indeed, for members themselves to see that their contributions are brief and thoroughly to the point. It may be mentioned incidentally that the Geological Society of South Africa is also an open society, without demands for qualifications of membership, and that any member is permitted to read a paper or criticism at its meetings. But this does not mean that every paper is published. Keen scrutiny is exercised when this critical stage is reached, with the result that this society presents transactions to the world that are a lasting credit to science in the Transvaal. There is no need for the C. M. & M. Society to adopt such stringent measures, but my plea is for the discouragement of length in papers, unless this feature is commensurate with the subject discussed. By repeating, with insignificant alterations, tables and diagrams, and padding out the descriptive matter with a host of reservations, all records as regards the weight of journals could be easily surpassed. Or, if necessary, the society could fall back on the accepted method of expanding its publications and printer's bill by publishing in English and Dutch.

Single-Stage v. Double-Stage.—In a contribution apparently more influenced by personal animus than a desire to advance technology, H. Stadler has criticized, in unsparing terms, the well-meant paper noted in the preceding paragraph. Mr. Stadler is one of the principal exponents of the single-stage crushing policy as opposed to the newly developed double-stage system, now accepted in the design of all new plants, and although generally most thorough in his investigation of details, is apt to flounder in his broader inferences. For example, he now states: "In face of the fact that the New Kleinfontein mine, run on conservative lines with single-stage crushing, without tube-mills, according to the report for 1910, still holds the record in reduction costs (4s. 6·7d. with 94·5% extraction on 466,882 tons per year) against two of the largest progressive mines (East Rand Proprietary, 5s. 5·8d. with 92·85% extraction on 2,126,324 tons, and Crown Mines, 5s. 9d. with 96·2% extraction on 1,511,658 tons), I cannot help feeling that metallurgical business on the Rand has become too refined, and that, from the introduction of the cyanide process to the present date, very little—if any—real economical progress has been made."

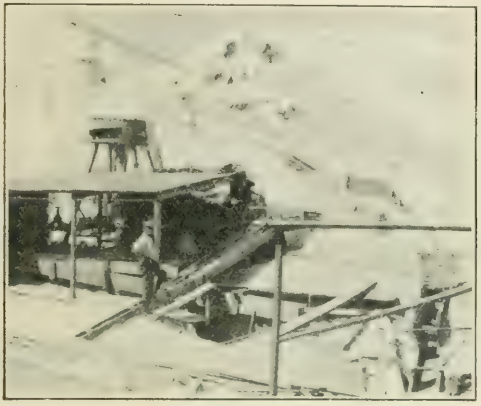
Debate on this unusual belief would merely lead to a most unprofitable argument on the definition of terms, but the foundation for the idea expressed is clearly fragile. A comparison of the reduction costs taken from the annual reports of the New Kleinfontein and Crown Mines is of small significance for the following reasons:

(1) The mines belong to different groups and there may be considerable differences in allocation of costs.

(2) The New Kleinfontein operates one mill and the Crown Mines three, whose costs are individually different and which include the comparatively inefficient old mill of the Crown Reef.

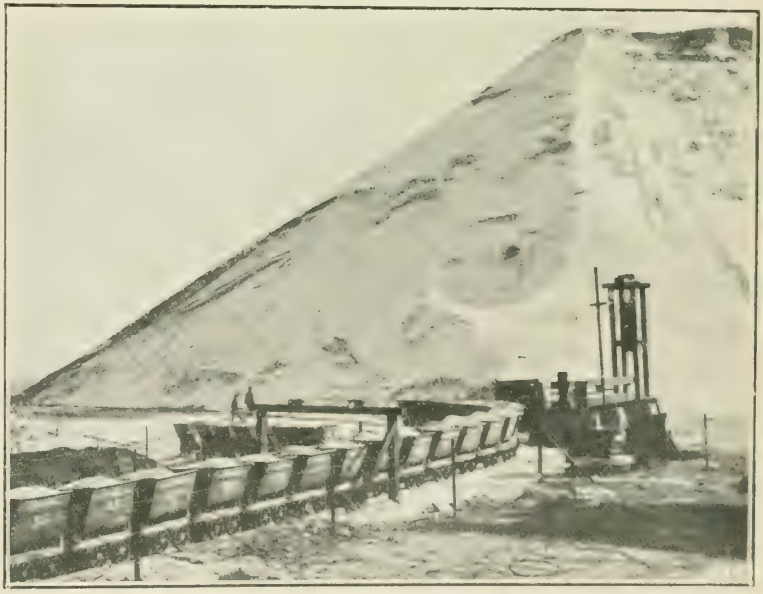
(3) The distinctions in the character of

East Rand and Central Rand ore are probably sufficient to account for a substantial difference in milling efficiency. The New Modderfontein mine, also in the Far East Rand, is very much lower in reduction cost than the average of the Eckstein mines, whose expenses are all kept on a uniform basis.



Sand-Filling at the Robinson.

Geldenhuis Deep Sand-Filling. — The photograph published herewith shows the sand-residue dump from which the Geldenhuis Deep draws its material for stope-filling. The experimental scheme for filling the trucks involves the use of the tunnel under the dump, the mouth of which appears in the picture. The trucks are run in and are filled through an opening in the top of the close-timbered tunnel, like the bottom discharge-door of a cyanide-vat.



Geldenhuis Deep Sand-Filling.

Coloured Wrappers for Explosives. —It is reported that a thorough test of the advantages to be gained by the use of coloured wrappers for explosives is to be made on several mines and on a scale that will at least ensure the issue of weighty opinion based on practical experience. The benefits of this scheme, which promises to effect the readier detection of unexploded gelatine in the stopes, amid the broken greenish-grey rock, have often been advanced. It is not that the paper will frequently be found adhering to the cartridge, but its detection anywhere will be a warning. The extra cost will be trivial and the results of the scheme will be appreciably in the right direction.

Average Depth of Ore Hoisted.—Although a vastly simpler question than the determination of the average grade of Rand ore for various depths, the average depth from which rock is today being hoisted is nevertheless difficult to ascertain without obtaining foot-ton statistics from all individual mines. An engineer has recently advanced the estimate of 2400 ft. as the average depth, but the basis of the estimate was obviously faulty. The figure named is certainly excessive. Although producing no conclusive result, it is suggestive to note that over 80% of the Rand's ore is obtained from mines that do practically no stoping below 2400 ft. vertical, while about 25% is drawn from mines with no stopes below 1000 ft. vertical. Assuming these last work at an average depth of 600 ft., that the balance of the 80% is from 1200 ft., and that the ore from mines with stopes deeper than 2400 ft. comes from an average of 3000 ft., we get a general average of 1410 ft. Allowing for development rock drawn from deeper levels than the stopes, a fair working figure of 1500

ft., average vertical depth, is arrived at. A detailed investigation of conditions in certain important areas proves this estimate to be highly reasonable. The average depth will increase steadily and surely, but the speed will be slow under present conditions. The increasing scale of operations in such outcrop mines as the Randfontein Central, Modderfontein, Modder B, Bantjes, the Paarl Central and Langlaagte Royal belonging to the Crown Mines, and the Benoni Consolidated will tend further to restrain the rate of increase in average working depth. A strip of ore along the Rand from Modderfontein to Randfontein, equivalent to a vertical drop of 500 ft., would contain over 125,000,000 milling tons. Judging by the tendencies of present expansion, it will be fully five years before the average of ore mined exceeds 2000 ft. vertical.

Corner House Policy. — Mr. Lionel Phillips took advantage of the East Rand Proprietary meeting to place on record his official views as to the most profitable policy to be pursued in modern Rand mining, and most emphatically gave his support to the camp of wholesale miners, whose colours have been rudely tattered during the past year by a transient whirlwind of higher economics. Mr. Phillips discussed the opposition policy of working out the richest areas first, in a striking way, and declared: "If in the mines they could pick out certain bags, as in a warehouse, and sample them as required, the policy of working the rich ore first would unquestionably be the right one." He urged that the soundest policy would be to "disregard as much as they could the question of unpayable ground"—this, of course, only in association with operations on a big scale. The meaning of this 'disregard' for the question of profit is clear enough and indicates that, with milling capacity beyond the standard of payable ore reserves, the "borderland" blocks will be worked or tested by stoping, and will be neglected only where they have been definitely proved to be unprofitable by adequate work. Mr. Phillips' statement should have a reassuring effect.

Electrification.—One of the most important papers read before a South African technical society for many months was delivered by T. P. E. Butt on May 13 at the S. A. Institute of Engineers, describing in detail the electrification of the Randfontein Central. The value of such a paper, full of facts and devoid of fancies, read at a time when electrification from central power-stations is a matter of general concern, cannot be over-estimated, from the standpoint of practical education. The power-station of the Randfontein Central has been designed to meet the demands of maximum sustained loads amounting to 14,000 hp., of which 6900 hp. is in respect of mining plant, including hoists, pumps, and compressors. The company's old power-station of 2000 kw. capacity has been increased to 20,000 kw., by the addition of three 2000 kw. sets, and two 6000 kw. sets. Mr. Butt summarizes the general features of the plant by noting that the scheme involves generating and transmitting at 6600 volts, 3 phase, 50 cycles; distributing at 2200 and 500 volts for motors, with further transformation to 120 volts for lights and underground pump-motors; the addition of underground cables as a means of transmitting and distributing; the adoption of turbines of the reaction type as the prime movers; and the adoption of a straight-tube boiler with provision for mechanical firing and consuming the cheapest coal obtainable. Covering the subject in detail, the paper is obviously not one to stand condensation. A section of peculiar interest is that dealing with capital and running costs. It is stated that actual expenditures came within 3% of the estimate, which was as follows:

Boiler-plant	£121,000
Cooling-tower, piping and launders	13,000
Generator and condensing plant	97,000
Substations	24,000
Transmission cables	21,000
Buildings	11,000
Workshops, artesian wells, etc.	16,000
	£303,000

Taking the power-station alone and including the cost of the first section of the plant, this works out at £16 per kw. of plant installed.

The working costs for March 1911 were as under:

	Pence per unit
Coal	0·153
Repairs and maintenance	0·046
Salaries and wages	0·035
Oil, waste, and stores	0·003
Office and general	0·007
	0·247

In this month, 5,085,430 units were generated, which, deducting auxiliaries, left 4,678,570 units for distribution at the switch-board. Lower costs will be attained under the best working conditions, which did not prevail in March.

Giesecke Tube-Mill.—Hitherto the old mill on the Geldenhuis Estate, on the ridge commanding the Bezuidenhout valley, has gained distinction as one of the only batteries on the Rand to possess sufficient natural fall to obviate the mechanical elevation of tailing. It has now sprung into sudden renown on account of the trials being made therein, by the Mines Trials Committee, of the newly introduced Giesecke tube or ball mill. It is as yet too early to speak with satisfactory finality as to the possibilities of this one-stage crushing machine. But as so much attention has been directed to its initial runs and such revolutionary consequences have been suggested in high quarters, some preliminary notes must be given and some opinions risked. The mill, similar in general appearance to the common tube-mill, is over 24 ft. long. The feed end of the tube is of greater diameter (7 ft. 6 in.) for a length of 6 ft., than the remaining 18 ft., which main portion is approximately 6 ft. in diameter. The mill, charged with steel balls (eight sizes) of diminishing weight from feed to discharge, rotates at 24 r.p.m. The feed end or breaking compartment is of bigger diameter and receives ore direct from the breakers, of a size fit for stamp-milling. The final discharge is said to contain 81% minus 200 mesh material and only 0·5% of 60 mesh, an 'all-slime' product. A duty of 360 tons per day is claimed, but more convincing statements are required on this point, not only to indicate the duty in the initial runs but also when wear and tear have played their part. A boast is made of the mill's ability to do the work of stamps and tube-mills, the crushing and the grinding, in one operation. In itself, this advantage is small. A simplification is of no importance unless associated with reduced cost. The fact that the mill is consuming much power in rotating a quantity of sand and slime, produced in the first chamber, and requiring no further pulverization, in its passage through the body of the mill, suggests useless work. The employment of independent units, stamps, and tube-mills, allows of a classification of products that prevents this. However, the true significance of these points will appear when trustworthy data are made available. In the meantime, the mechanical engineers (who are supporting the scheme rather than the seasoned metallurgists, within whose sphere such experimenting properly lies) would do well not to commit themselves too loudly as to the success of the trials. First, let them recognize that the consumption of steel has been the principal crux of wet ball-milling practice all the world over, and secondly that the Rand is equipped with reduction plants, to the value of many millions sterling, from which the last results have still to be obtained, whatever economies can be claimed by the Giesecke mill. An apparently strong case has already been made out in regard to saving of capital expenditure, but this comparison, after all, depends upon the duty maintained, and the figures here require substantiation. As for running costs, no authoritative statement can be made till we know the consumption of steel in balls and lining per ton of average deep-level ore crushed.

NEW YORK.

The stock market remains almost featureless. Of course, a certain amount of enthusiasm was manifested as soon as the legal status of the Oil and Tobacco Trusts was established by the Court, and mining shares participated with others in a sudden burst of activity, with rising prices. Prices still hold

Mazuma, Nevada.

up well, but the volume of business is small. Within the past month, Amalgamated has advanced $3\frac{1}{4}$; Miami, $1\frac{5}{8}$; Tennessee Copper, $3\frac{3}{4}$; and Utah Copper, $3\frac{1}{4}$. Goldfield Consolidated and Nevada Consolidated likewise record an improvement over a month ago, but to a less extent. Although the Trust decisions left no uncertainty as to the illegality of the two great offenders, which were on trial, a general feeling of unrest still prevails among those who manage the great corporations, and this is due probably to what amounts practically to a reversal of itself by the Supreme Court. Not so many years ago, in a similar case, the Court went on record, literally, as opposed to any assumption of legislative power through reading the word "un-

reasonable" into the Sherman Anti-Trust Act as an adjective qualifying "restraint of trade"; the same Court now expresses the opinion that the Act was intended to apply only to such actions in restraint of trade as are obviously unfair, "unreasonable," and opposed to common justice. This leaves the future position of hundreds of other corporations still open to suspicion, and until the fog is still further cleared away, it is not to be expected that many new enterprises of great magnitude will be launched. Investigation of the events leading up to the consolidation of the Tennessee Coal & Iron Co. with the Steel Trust is now under way in the Senate and many of the leading officials of the companies are being given an opportunity to explain an apparent breach of the law. As to the statement that the consolidation had the approval and sanction of President Roosevelt, it is now generally thought that the facts may not have been put before him in their fullness, and that certain prognostications as to the parlous times into which the country and the steel industry were drifting were somewhat overdrawn.

Mexican disorders seem in a fair way to be settled amicably. The attitude of Madero, the leading spirit in the revolution, is winning much applause, the more so, perhaps, because his willingness to remain in the background, while the Government was being readjusted along constitutional lines, was not wholly expected. Sectional disorders are still rife, and the Government's attempts to establish provisional rule in many of the States are not very successful. So far as mining is concerned, the revolution has not caused any serious losses or delays. The express companies, in some instances, have declined to accept consignments of bullion, but the mines in many cases have made the shipments at their own risk, and without incurring any great loss. Some of the railroads have been put out of commission, but these will quickly be repaired and mining operations ought soon to be resumed.

Tariff reforms are still under discussion, but no final action has yet been reached. The actual treaty under negotiation relates to Canada alone, but if this is approved by Congress, it is a safe prediction that other similar treaties, the aim of which will be to reduce the oppressive and preposterous duties levied by the Payne-Aldrich law, will come up for consideration, resulting, it is to be hoped, in a general breaking down of the barriers existing between the United States and all other countries. The farmers, for whose benefit all previous tariff impositions have, nominally, been enacted, are beginning to realize the hollowness of the arguments advanced in support of a tariff policy of protection, and are shifting the responsibility to the manufacturers, who are really the only ones benefited by such artificial barriers. The treaty with Canada has received favourable attention in the House, and while it is being unnecessarily delayed in its passage through the Senate, all signs seem to indicate that it will be passed without much alteration.

The copper market shows decided marks of improvement. In spite of the addition of new metal from the porphyry mines, and the failure of private agreements to curtail output from the older producers, the price is slowly climbing, under the stimulus of heavy buying in Europe; American consumers were slow to place their orders, but have now gone into the market with considerable alacrity, and Lake copper is now almost touching 13 cents. If general confidence in business affairs is ever restored, and a few of the long projected installations of electric traction enterprises are put under way, the market will show immediate improvement. In this connection, it is interesting to note the prevailing low price of aluminium. It can easily be computed that, for electric transmission, aluminium is the more economical metal whenever it can be bought at less than twice the price of copper. The best ingot aluminium can now be bought for 20 cents per pound, and the demand is dull at that price. It looks as though the wire-makers were neglecting an opportunity.

MEXICO.

After the Revolution. — The railroad lines recently damaged have been repaired, and traffic has been resumed. However, as much of the repair work has been of a temporary nature, it is feared there will be more traffic interruptions than usual from washouts during the rainy season now opening. Permanent repairs will be made as rapidly as possible. The losses sustained by the Southern Pacific have been placed at $500,000. No estimates of the losses sustained by the National Railways of Mexico and the Mexico Northwestern Railway have been given out. There was a decrease of 2,053,122 pesos in the earnings of the National Railways for the month of May. The Mexican Express Co., operating on the merger lines, has resumed the handling of money and bullion. Workmen at the Velardeña smelter of the Ameri-

can Smelters Securities Co., at the Torreon custom smelter, and at the Guggenheim mines in the Velardeña district of Durango recently went on strike for higher wages. Their demands were refused, and they returned to work within a few days. These strikes were preceded by similar strikes at the Matehuala smelter of the American Smelters Securities Co., and the Mapimi smelter of the Peñoles Mining Co. During the revolution there gained currency among Mexican workmen a report that in the event of Madero's triumph employers of labour would be forced to pay higher wages, and belief in this report had much to do with the strikes mentioned. The Chihuahua smelter of the American Smelting & Refining Co. was forced to shut-down late in May because of fuel shortage, but the period of idleness was brief. Cananea was without railroad communication with the United States during part of May, but the fuel-oil and coke supplies of the Cananea Consolidated (Greene-Cananea) were sufficient to prevent an interruption of the extensive operations of that concern.

A STREET SCENE IN MEXICO.

Pearsons.—Investigation of the holdings and business of S. Pearson & Son and the Mexican Eagle Oil Co. by officials of the Texas Oil Co. and the Gulf Refining Co., both Standard Oil concerns, has resulted in a report that the Pearson oil interests in Mexico may pass into the hands of the Standard. [The Texas Oil Co. is controlled by John W. Gates and John F. Harris, of Harris, Winthrop & Company—Editor.] In this connection it is recalled that the Pearsons were very close to the Diaz government, and were granted valuable concessions by that administration, and it is suggested that if they are now desirous of disposing of their oil interests, the recent political changes in Mexico may have something to do with it. The Pearsons entered the selling field in competition with the Waters Pierce Oil Co., a Standard subsidiary, in 1908, and the following year the Mexican Eagle Oil Co. was organized principally as a marketing concern for Pearson products, although at the time it was announced that the new company would also take over and work some of the Pearson oil-lands and concessions. Since the organization of the Mexican Eagle Co. there has been a bitter fight between that concern and the Waters Pierce for control of the oil business of Mexico, and consumers have benefited through the cutting of prices. It is stated that the Mexican company now controls nearly 40% of the oil business of the country. Prior to the time that the Pearsons entered the Mexican field the Waters Pierce was in

complete control, and its yearly profits were very large. The oil supplies developed by the Pearsons in the Potrero field in the State of Veracruz within the last few months have greatly increased the value of their holdings. During the progress of the Madero revolution it was repeatedly reported that the revolutionists were receiving financial aid from the Standard Oil Co. A formal denial of these reports was issued by the Standard some time ago, and since the cessation of hostilities Francisco I. Madero has stated that he received no financial support from the United States. Guillermo Landa y Escandon, Governor of the Federal District during the latter part of the Diaz administration, is president of the Mexican Eagle Oil Co., and the directorate includes Lieut.-Col. Porfirio Diaz, son of the former President, and Enrique C. Creel, former Minister of Foreign Affairs. The company was organized with a capital of 25,000,000 pesos.

Zacatecas. — The revolution interfered but little with operations in the Zacatecas district. The Zacatecas Mining & Metallurgical Co., organized in 1909 to work the San Cristobal and other mines in the 'gold belt,' is ready for milling, and expects to handle at least 100 tons daily. The company remodelled the milling plant at the San Cristobal mines, and built a cyanide annex. The properties included those handled twenty years ago by Whitaker Wright. M. E. MacDonald, prominently identified with the mining and milling revival in the Guanajuato district, is at the head of the company. The Santa Rosa Mining Co., controlled by the Exploration Co., of London, is making good progress with its mill plans at the Santa Rosa properties in the Concepcion del Oro district. The company will operate with electric power generated by a gas-producer plant. The San Carlos Gold Mines, also of London, has temporarily suspended operations at the San Carlos and Mesquital mines in the Mesquital del Oro district, pending more settled conditions in Mexico. The company has been milling successfully, and has plans for important betterments.

Parral.—This important district in Chihuahua was without railroad communication during the month of May; nevertheless the principal milling concerns continued to operate steadily. Shipments, of course, were affected. The Veta Colorado handled over 300 tons daily at its new plant, and expects to show an increase this month. Milling gains are being made by the Palmilla. An option to purchase 450,000 shares of Palmilla at $5 per share has been asked by strong financial interests of the eastern part of the United States, and it is believed that a sale will result.

West Mexican.—Now that railroad conditions are again normal, the West Mexican Mines Co. will resume work on its 200-ton reduction unit at its mines in the Guadalupe y Calvo district of Chihuahua. Shipments of machinery for the plant were held up by the cutting of railroad lines.

MELBOURNE.

Zinc Corporation.—The news received in Australia from London that the Zinc Corporation was to absorb the Broken Hill South Blocks company excited a great deal of amused comment. The finance involved may do very well for London, but the directors would be pretty bold who would come out here with such a scheme for an Australian-owned company. The fact that has to be established is that the South Blocks mine is a dividend-payer. So far the ups and downs of its shares in the market have indicated a manipulative power by some crowd that no one on this side of the equator wishes to meet in the dark. Here the policy is for the shareholder who puts up the cash to be first considered. So far is that principle carried that in most mining companies the paid-up and the contributing shareholder get the same amount of dividend though the contributing shares may be only paid-up 10s. in the £. If this treatment was not meted out the chance of obtaining capital for mines would disappear unless everyone was put on the same footing so far as contributions to the company go. Cash payment would be made for a claim and if calls had to be made all would have to pay. That the ordinary shareholder in the Zinc Corporation should be flooded with preference shares and have to carry more of his own class of scrip for the prospect of what he may get out of the South Blocks mine is a bit "over the limit" according to Australian ideas. When the Zinc Corporation was in a tangle it had to make the best terms it could to get cash, including the provision that the 'prefs' were to be refunded their capital. As beggars cannot be choosers, so the terms had to be swallowed rather than a reconstruction faced. The 'prefs' also took preferential voting power. The 'ordinaries' really sold their birthright and apparently would have done better to have washed their hands of the whole concern, had their contracts sold,

and taken their dividend in that way. Shareholders here await the justification for the amalgamation and they also resent the short notice given, a fact to which the attention of the Legislature may be directed whenever Australia succeeds in getting a Companies Act for the whole of the Commonwealth.

Etheridge.—Developments on the Etheridge field in North Queensland are of interest to the large body of shareholders in the Chillagoe company and the debenture-holders in the company's railway system. This is because the Chillagoe company has built the railway to the Etheridge in the hope of finding there supplies of ore for its smelters. The directors also are taking up options and the company has already done a certain amount of prospecting work. In this connection great importance attaches to the recent development at the Durham Consols mine, at Georgetown, where the lode has been cut at 750 ft. This is the deepest point reached in the district. The lode where cut was 4 ft. wide and the directors report that it averaged 5 oz. gold per ton. But on driving north and south the width shrank to 18 inches, though at the bottom of the drive the ore was a good deal wider. Assay-values still remained satisfactory though not so high as in the first cut. The Etheridge mine, a Chillagoe flotation, is interested in this strike because of the prospects on some of the blocks they hold. The fear was that at the Etheridge the somewhat narrow lode formations might peter out at depth, but the piece of evidence furnished by the Durham Consols so far has been to the contrary. The Chillagoe has also interested itself in coal areas at Mount Milligan in Queensland. Recently they sent J. T. Watson of Sydney to examine them. Mr. Watson has since been interviewed and he said that he was most favourably impressed with what he had seen. The field had the making of a large coalfield, as the coal-bearing country extends over an area of 30 square miles, and in Mr. Watson's opinion the work already done by the Chillagoe and Irvinebank companies was quite sufficient to justify further development on a large scale. In his report he was recommending the Chillagoe company to push on with further work.

Great Fitzroy. — Before this reaches London, D. P. Mitchell will have landed there and perhaps have disclosed all that he thinks of the Great Fitzroy and its lamentable failure. In looking up the records of the past one finds Government geologists and experts like F. B. Powell declaring that they "like the proposition very much and that with proper handling it will make a big and profitable mine." Some figured the recoverable values at 62s. and costs at 37s. 6d. But the price of copper was put at a much higher point than that at which it now stands. And it has been demonstrated that what may be regarded in a report as "recoverable values" do not always pan out as such. The difficulty with the concentrating mill was to handle the ore at all profitably. So at W. J. Loring's direction it was shut-down and a Minerals Separation plant was installed. This experiment has been watched with the utmost interest by metallurgists who united in hoping that the recovery would settle all doubt as to the ability of the flotation process to deal with low-grade copper ores. It can be asserted that the work done in that respect has not been altogether disappointing, as a satisfactory recovery of copper was achieved. But the difficulty that has not yet been overcome is to save the gold. The loss of this, from such a low-grade ore as that of the Great Fitzroy, and with metals at the present figure, meant financial shortage each month. So the plant has been shut-down, save the furnace. This means that the better ore will have to be utilized and as that is low-grade what is left will need exceedingly close treatment if it is to yield a profit, unless copper should follow in the wake of tin and advance to record prices.

Broken Hill.—The record of the Broken Hill Block 10 mine is one that may well be quoted. The block of 35 acres was the bonanza of the field outside the Proprietary Company's three big leases. It was owned originally by that company and was floated with a capital of £1,000,000 in £10 shares. The company was incorporated in March 1888 and ore was struck in December 1889, it being magnificent in point of richness in silver. To March 31 last the company raised 1,940,322 tons of ore, of which it concentrated on the mine 1,817,315 tons and sold 123,007 tons of crude ore. It still has a reserve of 550,000 tons of ore, a good deal of which is above the 1000-ft. level. The gross contents of the ore treated was 35,598,545 oz. silver and 350,838 tons of lead. In addition, the zinc contents were roughly 330,000 tons. The gross value of the silver and lead alone at today's prices is £7,769,000 and the total dividends paid have been £1,245,000 or an average for 21½ years of £58,000, one year bringing in £295,000. The working capital was of the smallest and therefore the company has a proved a splendid investment.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

June 1911	May 1911	June 1910
£56. 9s. 10d.	£54. 8s. 7d.	£58. 8s. 11d.

The course of prices has been steadily upward reflecting the more hopeful views entertained as to trade conditions in America. These views are strengthened by the further decrease in the world's stocks as revealed in the May figures of the American Producers' Association and by the expanding demand from manufacturers both in Europe and America. In Europe the consumption for the past 12 months was 504,191 tons, compared with 391,243 for the previous year. In America domestic consumers took 5418 tons more in May than in April, while most encouraging reports are received as to June deliveries. A sign of reviving confidence is the increase in interest taken by private speculators who are buying quietly on every decline in price. There is a constant though unobtrusive demand in influential quarters for standard sorts that betokens confidence in the future of prices. Producers have raised their prices for electrolytic to 12¾ cents in New York, and as they have sold well during the past few months and are encouraged by the promising trade outlook, they are able to remain independent for some time. A further rise is not improbable. English prices of electrolytic show a rise of £3 during the month. The holidays and the labour troubles have interfered but little with the markets. Heavy sales of Japanese copper have been made to the Chinese government.

TIN.

Average prices of cash tin:

June 1911	May 1911	June 1910
£207. 7s. 9d.	£197. 15s. 4d.	£148. 13s. 1d.

This market has again passed through one of those spectacular and rapid changes for which it has become notorious and which gives rise to so much difficulty and irritation to legitimate dealers and consumers. Having once more lured the unwary to create a considerable bear interest, the syndicate gradually proceeded to punish them by establishing a backwardation of no less than £43, and only when the bulk of the commitments had been cleared off, did they permit more normal conditions of business to prevail. Consumers, reluctant to pay the enormous premiums exacted, had kept out of the market, and when prices fell again they were found to be heavy buyers especially in America, and absorbed large quantities of the metal. The amount of solid business is so great as make it apparent that the world's supplies are insufficient for its needs. Every fall in prices witnesses heavy purchases by the trade, and the fluctuations in stocks are only brought about by manipulation of prices. Meantime a further upward movement seems inevitable.

LEAD.

Average prices of soft lead:

June 1911	May 1911	June 1910
£13. 5s. 5d.	£12. 19s. 2d.	£12. 13s. 9d.

Lead has been scarce and buyers clamorous for supplies; prices consequently have been buoyant. The consumption shows expansion and the usual sources of supply have been insufficient for the London demand, so that American refineries have been called upon to make up the shortage. The stocks there are, however, greatly depleted, and in view of the curtailment of the Mexican supplies it seems doubtful whether they will continue to provide the tonnage they have been sending.

SPELTER.

Average prices of ordinary brands:

June 1911	May 1911	June 1910
£24. 9s. 7d.	£24. 6s. 1d.	£22. 3s. 2d.

Further increase in the production of this metal seems impossible, as the existing works are at their fullest capacity and are unable to cope with the demand. The quantities offered by the syndicate are being narrowed down as much as possible and prices have been raised a further 5s. per ton; but the demand keeps growing, and the galvanized iron trade is expanding in a way that could never have been foreseen.

OTHER METALS AND MINERALS.

Prices quoted on July 10:

SILVER.—24½d. per oz.

PLATINUM.—172s. 6d. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£61 per ton.

NICKEL.—£169 per ton.

COBALT.—9s. 9d. per lb.

ANTIMONY.—£29 per ton.

QUICKSILVER.—£8. 5s. per flask of 75 lb.

MANGANESE ORE.—9d. to 9½d. per unit (1%).

IRON ORE.—Cumberland hematite 19s. 6d. per ton at mine. Spanish 19s. delivered in England.

PIG IRON.—Cleveland 46s. 6d. per ton. Hematite 62s. per ton.

WOLFRAM ORE—31s. per unit (1%).

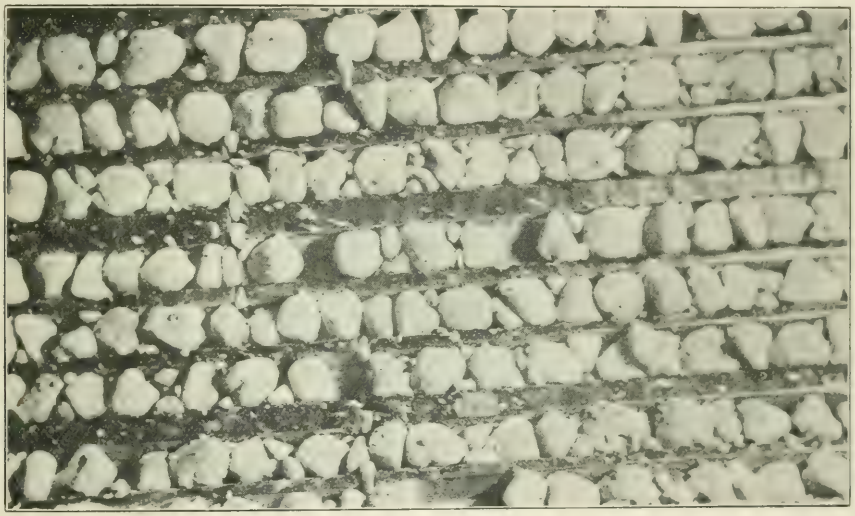
DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Tube-Mill Lining.

The Editor:

Sir—The accompanying photograph shows the way in which the pebbles set themselves in the ribs of the cast-iron liners placed inside the shell of the tube-mill, thus forming the well known El Oro type of liner. In this particular case the tube-mill, 16 ft. long by 3 ft. 6 in. inside diameter, is part of the equipment of the La Ceniza mill, situated about 40 miles east of Guadelupe y Calvo, the ancient capital of the State of Chihuahua, Mexico. All supplies have to be carried on mules from the nearest railroad, the Ferrocarril Parral y Durango, at a cost of 50 pesos (£5) per ton, 8 or 10 days being occupied in the transport.



TUBE-MILL LINING.

To effect a reduction in the working cost a successful attempt was made to obtain a suitable pebble on the mine. The central portion of the vein being worked is an extremely hard, whitish, chalcedonic quartz, in places having the appearance of true flint, in others it is banded like agate. It is quarried at the most suitable places along the outcrop, the large pieces being reduced by hammers to the requisite size: 4-inch cubes. These cubes are filled into the mill without water, the mill is revolved for 8 or 10 hours, after which pebbles similar to those shown in the photograph may be taken out. The contract price for the cubes is 8 pesos (16 shillings) per ton delivered at the mill; about 25% of weight is lost in the grinding; 2 pesos will cover the power and labour; so that they may be produced for about 12 pesos (24 shillings) per ton.

Imported Danish pebbles would cost about 90 pesos (£9) per ton at Tampico; mule freight of 50 pesos, with rail freight to Parral and agent's charges would bring the cost to over 150 (£15) per ton, so that the large saving more than counterbalances the slight inferiority of this pebble as obtained locally.

A. N. MACKAY.

Wimbledon, May 2.

Fine Grinding.

The Editor:

Sir—In an article in your March issue on fine grinding, the author, Mr. H. S. Denny, advocates a wider application of the method, and predicts its almost general adoption in the future.

After defining 'all-sliming' as a term applicable to the grinding of an ore to pass 100-mesh, or finer, the author discusses the question of the limiting factor and efficiency, and defines the former as the comparison between "the added cost of each unit of fine grinding, and the added extraction." This is a vague statement which apparently takes notice of increased capital necessary, but not increased running cost. The next assumption that the author wishes to allow is that "the actual work done can be measured against an accurate record of power consumed in doing that work." This is also vague, but I presume that the author is confining himself to the

question of power consumption and means to say that, as regards 'all-sliming,' the power consumed by the classifying and re-grinding plant, return-pumping systems, settlers, agitators, and filter-press plant, can be estimated more or less exactly.

We next come to a theoretical example of the advantages that Mr. Denny supposes would accrue by the adoption of 'all sliming' in the case of a simple gold ore carrying 8 dwt. per ton. The ore in question is a silicious one, containing 5% pyritic material, 90% of the latter carrying 70% of the gold. This material is crushed to 60-mesh, and it is next assumed that the metallurgist would agitate and filter-press this product, with a resultant recovery of only 80%. According to Mr. Denny "the question would then arise as to the application of finer grinding, and in what particular form."

The next assumption is that, if the products were re-ground to pass 200-mesh, the extraction would be increased from 80% to 94%. The extraction from the original slime would remain at 80%. By a comparison of these figures we find that the assumed residue resulting from the filter-pressing of sand and slime would be 1·6 dwt., and that after re-grinding this would be reduced to 0·54 dwt., being a net increased recovery of about 1 dwt. per ton. This profit would be reduced to about 0·3 dwt. when allowance had been made for the extra cost of re-grinding, which Mr. Denny's experience puts at 3s. per ton.

Later in the article the author admits the impracticability of filter-pressing a mixture of coarse sand and slime, and we are therefore forced to the conclusion that the whole argument is based on an absurdity, and that, had the sand been leached in the first instance, at a fraction of the cost involved in agitation and filter-pressing, a net saving in favour of separate treatment of sand and slime would have been the result.

Mr. Denny, in an attempt to justify a conviction that 'all-sliming' will be the tendency in the future, is advocating it as a general method and, in order to convince his readers, quotes at length Mr. Grothe's excellent suggestions as regards the handling of treatable concentrate in an 'all-sliming' plant. This is another aspect of the matter altogether and is quite distinct from the idea of erecting a plant to slime sand in order that a small percentage of concentrate may be very finely ground.

Fine grinding should be carried to such a degree that subsequent treatment yields the best net result and the highest net profit. If economy and improved extraction ensue the concentrate should be removed (if fine grinding is not being practiced) and treated separately. There are several excellent makes of grinding-pans that have proved efficient for the grinding of concentrate to any degree of fineness. The practice of sliming concentrate has been in use in Western Australia for a number of years, and has given excellent results at a minimum of cost, the agitated concentrate being handled in the presses with the ordinary slime. This method also allows for the roasting of the concentrate beforehand, and considerable economies have been shown to result from the adoption of the latter practice, in the matter of subsequent reduction of cyanide consumption. Pachuca tanks have proved most efficient for the agitation of slimed concentrate.

Fine grinding is as obviously necessary for the gold ores of Kalgoorlie as it is for the silver ores of Mexico. There are other districts, however, where the expenditure is not justified by the results. Mr. Denny, in his article, is dealing with "simple gold ores" and states that "the day of the percolation method of treatment for sand and the decantation system for the treatment of slime has gone." I would like to state that Rand practice is not universal and that there are better and more up-to-date methods of slime treatment than that of decantation, and that these can be used equally well for handling the slime in conjunction with the percolation treatment of the sand.

In spite of Mr. Denny's predictions, I have no doubt but that metallurgists will still encourage whatever process is best suited to local requirements, and, in dealing with the fine grinding of simple gold ores, will duly consider whether the increased yield resulting from its adoption is in due proportion to the increased capital expenditure and the necessarily higher running cost.

A. W. ALLEN.

Cuñapirú, Uruguay, May 6.

Appointments Vacant.

The Editor:

Sir—Could you find space in your valuable journal to comment in some way upon the ridiculous advertisements that so often appear under the above heading in our English technical journals?

Vague statements, such as "Metallurgist wanted for Timbuctoo. State experience and salary required," are fairly common. Applicants are expected glibly to state "salary

required" without having the remotest idea of the extent of their duties and responsibilities or for what kind of a position they are really applying. It is our English firms who are the chief offenders with these cheese-paring methods, both in advertising and selection of applicants. "Salary required" is more often the vital question, and "experience obtained" a minor and unimportant detail.

R. H. B. BUTLER.

London, June 22.

[We refer to this subject in an editorial paragraph.—EDITOR.]

Mexican Affairs.

The Editor:

Sir—I again take the liberty of submitting the following lines to rectify some groundless and false appreciations contained in the pages of your valuable issue of January last, which I have just perused.

Therein, Mr. Theo. van Wagenen, in an article styled 'More about Mexico,' presents, in a cursory way, his views on the political situation of my country, partaking himself of a common misconception to foreign travellers and even to residents of the English-speaking class, who for some reason seldom come in touch with well informed natives, and hold very superficial ideas on the subject. As a result of this lack of information, the history of Mexico becomes rather twofold.

For such superficial observers, modern Mexico and Porfirio Diaz are the same thing, the latter being the creator of the former. They suppose that when General Diaz assumed power in 1876, Mexico was quite a barbarous country plunged in darkness and strife, a land wholly insecure for life and property, and that Diaz has transformed it into a hospitable place in the community of nations.

As against the above, history itself asserts that in 1867, when Benito Juarez, the greatest president that Mexico ever had, passed the penalty of the law on Prince Maximilian, of the Hapsburg royal blood, Mexico was already a civilized country, where a vast number of her people loved peace and could appreciate its blessings. From the year 1867 down to 1876, it was General Diaz, the only revolutionist in Mexico, whose ambition for power troubled the country.

That after his success the Mexican people should have abided by his autocratic regime, cannot properly be construed a blame nor a lack of patriotic feeling in the masses; it was the reverse; it was a conscious offering in the shrine of peace; it was the abdication of political liberties for a time for the sake of national welfare.

Mr. van Wagenen asserts that we are not worthy to control our own country; that when General Diaz disappears we shall be like orphans. This disparaging prediction, if it proves anything, only proves Mr. van Wagenen's ignorance of our true social condition, and I sincerely lament that such erroneous statements should have appeared in a paper so deservedly esteemed as *The Mining Magazine*, for they may elicit the suspicion that in other matters its columns could be equally misleading.

Just at this moment, Sir, the Mexican people, throughout the Republic, are celebrating the downfall of Diaz and his exile under the ban of public opinion. This is the work of Mexican patriots. Yet, we have worthy and capacious Mexicans who will replace him in power, who will be far from perpetuating his autocratic system of rule; who will uphold the laws of the land, and while allowing foreigners to partake of the national wealth, will not make of that a privilege. The blame that Mr. van Wagenen puts on Mexicans will cease henceforth, and a new era of self-government will ensue.

Lacking the necessary time to refute all the points in Mr. van Wagenen's long stricture, I will but refer to his imputation that a return to the old revolutionary days in Mexico would join the upper class with the foreign element in a demand for peace at any price, even if that price should be the extinction of our nationality. Where has Mr. van Wagenen resided in Mexico to forestall such public sentiment? What persons are those whose acquaintance he has made to warrant his unqualified idea? It is a pity to see your worthy magazine the sponsor of these paltry absurdities!

But the present revolution will serve to disprove them, Sir, for the contending parties, the Government class and the revolutionist both, have repeatedly disowned the interference of a foreign power in their domestic brawl. To be sure, the large majority of the nation consider the preservation of national independence as the highest gift they possess, as well as the foundation of their honour as citizens and as men, any affirmation to the contrary being fallacious, and too destitute of truth to arrest the attention of any righteous sensible person.

LEOPOLDO SALAZAR.

Mexico City, May 28.

Calculations of Percentage of Recovery..

The Editor:

Sir — The article by Mr. Theodore J Hoover which appeared some months ago in *The Mining Magazine* has already had a liberal share of discussion and has brought an interesting and valuable formula to the attention of many. Some engineers had made use of a similar formula in calculating or checking their mill-recoveries and have mentioned the fact in your columns. To me the formula was new and I have found it most useful not only in determining the total extraction but in computing the recovery made by separate concentrating machines such as a jig, a table, or a magnetic separator.

In making tests, however, of the efficiency of a jig or of a table concentrator one has a middling product to deal with which is not provided for in the Hoover formula. To take into account this middling a formula has been derived as follows:

A = weight of feed, B = weight of tailing.
a = tenor „ „ , b = tenor „ „
C = weight of concentrate, D = weight of middling.
c = tenor „ „ , d = tenor of middling.
R = Percentage of recovery.

(1) $Aa = Cc + Dd + Bb$

(2) $A = C + D + B$

(3) $R = \frac{Cc}{Aa} = \frac{Cc}{Cc + Dd + Bb}$

Substituting A in (1) gives

(4) $C + D + B = C\frac{c}{a} + D\frac{d}{a} + B\frac{b}{a}$

To find B we have

$$B\left(1 - \frac{b}{a}\right) = C\left(\frac{c}{a} - 1\right) + D\left(\frac{d}{a} - 1\right)$$

$$B = \frac{C\left(\frac{c}{a} - 1\right) + D\left(\frac{d}{a} - 1\right)}{1 - \frac{b}{a}}$$

$$= \frac{\frac{C}{a}(c - a) + \frac{D}{a}(d - a)}{\frac{a - b}{a}}$$

$$= \frac{C(c - a) + D(d - a)}{a - b}$$

Substituting B in (3) gives

$$R = \frac{Cc}{Cc + Dd + \frac{C(c-a) + D(d-a)}{a-b}b}$$

$$= \frac{Cc(a - b)}{Ca(c - b) + Da(d - b)}$$

This is a formula for determining the recovery, including that from the middling. It is necessary only to weigh the product and the middling. To determine the weight of the material treated the following formula was derived:

$$= A\frac{C(c - b) + D(d - b)}{a - b}.$$

In this it is also necessary to know the weight of the product and middling.

C. W. WRIGHT.

Pertusola, June 16.

The Finance of a Mine.

The Editor:

Sir—In his letter of last month, Mr. Fern places his finger on several features the definition of which brings out sharply the difference between mining as an industry and as a convenient means of public exploitation: this is the perennial fight between the engineer bent on economics and the engineer inspired by hope of promotional favour.

The principal points raised by Mr. Fern may be summed up as follows:

(*a*) The scanty nature of the data supplied to the mining investor;

(*b*) The technical skill required to interpret such data;

(*c*) The difficulty of dealing with base-metal mines, the product from which varies greatly in price from time to time;

(*d*) The definition of what constitutes a reserve, hence the 'life' allowance necessary;

(*e*) The dearth of maps and statements of costs and losses;

(*f*) Methods of reporting results as, for example, from vanning and chemical analyses;

(*g*) Status of small mines as regards the big properties.

While my articles will deal with each of these points incidentally, I may say now that:

(*a*) There is no justification for the dearth of data supplied, nor is this a matter of unsupported opinion, for many companies publish full reports and plans: *vide* the Great Boulder Proprietary Co.'s annual report of 1910, where the position and general allowance for the blocks of ore classed as reserves is shown clearly by longitudinal section. By far the majority of mines could be illustrated diagramatically as in Fig. A, with the levels, winzes, etc., shown in solid lines and the faces in process of being extended by broken lines.

The outlook of the mining engineer is the resultant of at least three powerful forces, that of promotional influences, an instruction that subordinates economics to technique, and

the uncertainty inherent to exploratory mining. The latter acts in many ways, both as tending to discourage accuracy in thought as well as commitment, which latter may afterward be used in censure. In general, however, we may safely say that the modern engineer is willing, in fact, would take pleasure in presenting full detail, but this is not usually favoured by financial chiefs except in the case of the more reputable concerns. The miserable pretence of conciseness, the pitiful drivel of accuracy shown in some company reports, with pages of unedited assay-returns, is a monument to incompetence, while being at the same time an admission of the justice of the demand for detail.

As will be demonstrated later in the series of articles, it is one of my contentions that most mining enterprises in any stage may be regarded as an industry and as such may have its salient economic points set out on a single sheet of paper as concisely as an ordinary balance-sheet. For instance, were a half-yearly or even a yearly diagram like Fig. A supplied and accompanied by a tabular statement of assets like that shown in Table B, far the greater part of mining swindles would become a memory of the "bad old times," for so the present day will inevitably be classed a few years hence, because of our too frequent vicious practices.

(*b*) With reference to the remark that technical skill is required to decipher mining reports it must be admitted that such is often

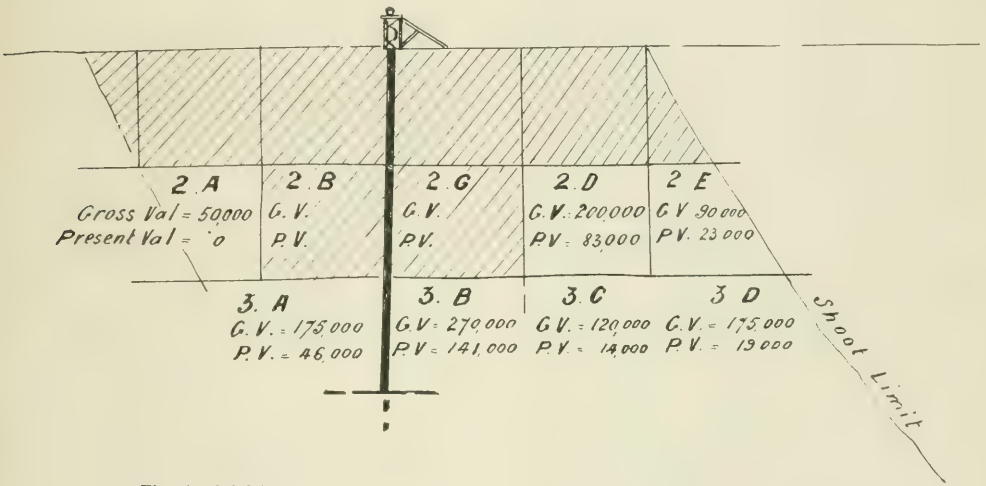


Fig. A. Solid lines indicate work accomplished. Broken lines indicate work in progress.

TABLE B.

Table of Assets June 30. Copper calculated at £60, Silver at 2s.

No. of Block	Tons of Ore	Gross Value £	Net Value £	Deference in years	Risk Rate used	Present Value £	Remarks
2A	50,000	50,000	–	–	–	–	–
2D	110,000	200,000	90,000	–	5%	83,000	Four sides sampled
2E	90,000	120,000	30,000	2	7%	23,000	Three sides sampled
3A*	100,000	175,000	75,000	3	10%	46,000	Two sides sampled
3B*	90,000	270,000	180,000	1	10%	141,000	To be stoped after 2 D: 2 sides sampled
3C*	80,000	120,000	40,000	4	20%	14,000	One side sampled
3D*	110,000	175,000	65,000	5	20%	19,000	One side sampled

*In practice the dimensions allowed this block would be governed by the factors represented by Formula X of the second article.

the case, but this is not inherent to the business; lack of exactness only proves that the engineer is party to intentional ambiguity or is wanting in that sense of economic proportion which seeks to simplify and express technicalities in monetary units. For example, by Fig. A and Table B without any technical help it will be seen what development of the ore has been accomplished and what in progress: what ore is 'blocked' (2 D) and the degrees of development on the other blocks: the gross as well as the estimated present value of each, and the proposed order in which to work the blocks. Thus, on account of the high value of Block 3 B, it would be economically sound to work this first, though like many other points of similar nature this would be governed by mining conditions. In general, sound business principles are overridden by engineers oblivious to financial economics who, when the latter are discussed, immediately offer some technical objection whereby to hide ignorance. The measure of the engineer is his ability to interpret and avoid technicalities, but the financial world is too often taken in or silenced by a technology as devious in its aim as the dog Latin of early prelates.

(*c*) Another mark of the modern school is the tendency to express metal contents in monetary units, and while the fluctuations in value may not be avoided any more than variations in working cost in different parts of a mine, so long as the price of the metals which forms the basis of the estimate is given, no real ambiguity exists. Surely this were simpler for an investor than to have to calculate for himself on all occasions instead of only those when the calculated price varies greatly from that obtaining later.

(*d*) The second article of the series dealt with this question of determination of reserves, but Table B accompanying Fig. A will perhaps also make it clear to anyone familiar with the principle of deferred annuities.

(*e*) What is urged regarding the dearth of detail as published by mining companies is unfortunately true, especially of Cornwall. In general it may be put down as due to a feeble effort at cunning, but occasionally to business ineptitude or moral cowardice on the part of managers and engineers. The mining investor's remedy lies in protest at the annual meetings, coupled with evidence that fuller details are published by other companies. In a country like England, where civic usually succeeds financial ambition, few directors like to be held up as an example of those who hide facts from shareholders.

(*f*) With regard to results had by vanning or chemical analysis, as before stated, mining is an industry and as such its results should be expressed in monetary units. For the investor the gross value in the ore and the costs and losses are what he really wants to know. Evidently crude operations like vanning, however useful in their places, give no true record of actual content either in heads or tails, and yet these must be known if efficiency is to be gauged.

(*g*) With regard to Mr. Fern's impression that the value of small mines is overlooked and great ones only to be ranked as investments, it may be as well to emphasize the fact that the opposite opinion is held. If sufficient reliable data can be obtained, it is hoped to show that many small mines are far sounder financially than great ones. Though they have the advantage of a higher class of technical advisers, financiers, and engineers to direct them, the larger concerns usually have a greater proportion of the capital represented by 'possibilities' only. It is the writer's belief that the tendency or desire to speculate by investing in any sort of enterprise which develops mineral deposits or opens new country, has its roots in national virility as surely as the trading, fighting, buccaneering enterprises of John Company days. Share speculation based on " the other man's " credulity is quite another matter and is as unsound economically as defective from a civic point of view. The question raised concerning the degree of development necessary before ore can be classed as reserves, is the very basis of mining finance and should the second article not have made clear the contention that ore opened on one side only may also be so classed, I shall be very happy to elaborate this point later. As will be seen, this view is entirely in favour of small mines, and I am in perfect accord with Mr. Fern's idea that any propaganda likely to injure the latter in the public estimation would be a great pity and a national loss.

M. H. BURNHAM.

London, June 27.

Beginnings of Cyanidation.

The Editor:

Sir—I have read with great pleasure Mr. McCombie's article on this subject, and congratulate him on presenting your readers with a clear account of the early history of this important industry. As far as I can judge, Mr. McCombie is absolutely accurate in all his statements, but one. He reports Mr. Dempster as among the dead. I am happy

to inform you that he is very much alive. He has been associated with me since the beginning of cyanidation, and is still busily engaged in erecting cyanide plants all over the world, and in doing similar work.

In order that there may be no mistake about this I have asked Mr. Dempster to report himself to you at the first opportunity. No one will be better pleased to be corrected in this matter than Mr. McCombie himself.

JOHN S. MACARTHUR.

Glasgow, June 21.

Mexican Unrest.

The Editor:

Sir—In the March number of *The Mining Magazine* you refer, under the head of 'Mexican Unrest,' to the subject of the possibility in the future of the annexation by the United States of the four northern States of Mexico. This is not the first occasion on which a similar utterance has come under my notice.

I think I am not alone, by a very long way, in feeling that anything tending to the disintegration or re-partition of this historic country, at length arrived at a position of distinction among modern nations, is to be deprecated. The object of this letter is not to discuss faults of internal government which have led to the recent troubles, nor to canvass the political situation, but merely to point out that by reference to such possibilities, which in your article you also would seem to deprecate, you prepare the public mind to accept them even as probabilities. What we are accustomed to hear mentioned is apt to lose by degrees the acuteness of the first shock of surprise and we become prepared for what we hope will not happen.

That large sums of capital from the United States of North America are invested in Mexico is, of course, a fact, but there are also large sums invested by other nations, though in somewhat less degree. To say that there is any preparation for annexation by the importation of American sentiment is going too far. The Mexican character is perhaps more strongly marked in the north than elsewhere, as evidenced by the recent strenuous and effective efforts of the native population. I think that it is not merely an inborn conservatism or sentimentality on my part that makes me hope that never will the area of this great country be further encroached upon or diminished, but that its development will be assisted by an even greater influx of foreign capital than heretofore. The mere suggestion to the Mexican mind that the presence of foreigners in their midst has for its object the disintegration of their country cannot fail to destroy the friendly relations that are so necessary for the development of enterprises engineered by the foreigner; and the sooner and the more completely that is recognized by the world at large the better, and then we shall hear no more of the 'annexation' chimera.

I have, Sir, the greatest regard for your fairness and foresight in discussing matters of grave importance, but I am wondering whether in your recent utterances you have considered their far-reaching effect, seeing that your magazine enjoys a position which I think I may say without flattery is unique in the world of mining.

WILLIAM CROSLEY.

Chihuahua, May 10.

Technical Sensationalism.

The Editor:

Sir—At the last meeting of the Institution of Mining and Metallurgy the remarks made in the discussion on Mr. Schmitt's paper were mostly in accord with those made by your Johannesburg correspondent. It was felt that Mr. Schmitt's assumption of the lowering of grade in depth was without solid foundation. As indicated by one speaker, the mere study of 'returns' without taking into account all the factors tending to bring about a lower grade is misleading. One such factor, as was mentioned, has been the gradual and increasing inclusion, from the early days up to the present time, of large blocks of ore formerly too poor to be profitably mined but which owing to reduced costs have gradually fallen within the limits of payability.

Another speaker mentioned that expansion had taken place on the Rand, not only in depth, but on all sides, and a comparison of average ore-value from returns of deep-level and outcrop mines might possibly destroy the impression that there was this drop in grade. The same speaker, referring to Mr. Schmitt's assumption that mining costs would increase with depth, remarked that although power consumption would certainly be greater yet with the advent of large central supply-stations they might actually be reduced.

The importance of the question of mining costs was emphasized in another contribution to the discussion, in which it was put forward that no field offered such possibilities for reducing working costs as that underground. Reduction in this respect had been made in the past and it was reasonable to suppose that a

urther and greater reduction was going to be made in the future.

Your correspondent mentions the inaccuracy of some figures employed in calculating the cost of sorting (this was noticed at the Institution meeting), and he goes on to say: "The cost of sorting, it should not be necessary to explain, is chiefly governed by the percentage of rock sorted out, not by the percentage looked at, as it travels along a belt." I feel sure this explanation is not necessary, as Mr. Schmitt, on page 24 of his paper, in arriving at operating costs states clearly: "Sorting, per ton of waste discarded . . . 1s. 0d. It seems he has confounded the figures in some way and I think your correspondent overlooks this in his endeavour to condemn the paper in a wholesale way.

It must be acknowledged that inaccuracy, especially in figures that have so important a bearing on the results which Mr. Schmitt wishes to bring out, must somewhat discount the value of the paper. In Table IV, A (16% basis), seemingly the saving in operating costs with Mr. Schmitt's proposed plants should average just under 5d. per ton hoisted, as against the average saving of just under 8d. per ton hoisted obtained from the above Table. In Table IV (30% basis), however, the figures showing the saving per ton hoisted, due to his proposed plants, would appear to be slightly favourably affected by amending the figures for 'sorting.'

No doubt many of Mr. Schmitt's assumptions are ill founded, as has been suggested, but it has yet to be shown that a saving could not be effected by the adoption of certain of his proposed modifications of plant, and at any rate I do not think that he should be accused of a lack of knowledge of the conditions governing the cost of sorting.

J. C. S. WHITTUCK.

London, July 6, 1911.

Freiberg. — A preliminary gathering of old Freibergers was held at the Gambrinus restaurant in London on June 30, the following old students being present: G. Percy Ashmore, S. H. Blandy, A. G. Charleton, Harry J. Donkin, W. R. Feldtmann, J. A. Henderson, E. Hooper, L. Kapps, L. Kessler, C. A. Mackenzie, E. P. Rathbone, H. M. Ridge, and A. R. Sawyer. It was unanimously decided to form an Association to be called 'The Old Freibergers,' which would hold periodical dinners. The honorary secretary is Edward Hooper, of 3 London Wall Buildings. Old Freibergers are requested to put themselves in touch with him by sending their addresses.

PORCUPINE

By RALPH A. MEYER

THE market at the moment is watching nothing so closely as the extension of the railway line into Porcupine, which it is now pretty well assured will be there the first of July. As a matter of fact the rails are already laid within one-quarter of a mile of South Porcupine, and both passengers and freight have been coming in all the way from Kelso as far as Frederickhouse by means of an accommodation train, and from Frederickhouse to Golden City (North Porcupine) by means of the rail and ballast trains. It is not to be expected that this itself would prove a factor of any importance in determining the trend of prices, or even in influencing to the slightest extent the sentiment among speculators. It is, however, a card that will be used and the market is not averse to holding such a card at this very time. The coming of the first passenger train into the district will ensure a big influx of mining men. Even now the hotels are crowded, and I am afraid much discomfort will be caused by inadequate accommodation. The completion of the railway will hasten the transfer of machinery to the mines, and it is only to be expected that a great deal of activity of the right kind will ensue. The recent conflagration tended to delay such a result, but not for long. It is announced that several companies, such as the Hollinger, have already ordered new plants to replace those damaged by the bush fires. The Hollinger company has decided to erect a mechanical workshop on a large scale in order to facilitate repairs to the machinery that suffered by the recent fire. Meanwhile, the management will be enabled to push intelligent and aggressive prospecting on the surface.

It is rumoured that the Lewisohns have purchased the Schumacher veteran claim, consisting of 160 acres in Tisdale township, immediately south of Pearl Lake and the Timmins property, and close to the Hollinger. Mr. W. H. Weed, consulting geologist to the firm mentioned, has recently been to Porcupine, and expressed a favourable opinion. He states that in all of the development properties, in addition to veins carrying spectacular showings of free-gold, the wall-rock is impregnated with pyrite carrying gold and readily amenable to cyanide treatment.

The work of the Dome Extension is attracting attention. The big vein discovered a month ago has been uncovered. It is 36 ft. wide, and

running parallel with it are four lateral veins, from one to three feet wide. Between these lateral veins the schist pans gold,and the whole orebody is over 50 ft. wide. The main vein is composed of quartz, which is good mill-ore. Samples across the vein have run as high as $32 per ton. The lateral veins are rich, showing visible gold in many places, and yield assays running into hundreds of dollars.

It has been announced in London and Toronto that the Bewick-Moreing interest, formerly known as the Northern Ontario Exploration, has issued a subsidiary christened the Ontario Porcupine Goldfields Development Co., with a capital of £600,000. The holdings of the said company comprise 50 claims, distributed over the Porcupine area, that formerly belonged to the Timmins-McMartin-Dunlap syndicate. The new company takes entire ownership of all of these claims and has formed a strong organization to carry on the work of development. A cash fund of $435,000 has been raised, and this with $60,000 provided by the former owners makes a working capital of about $500,000 available for development. The advisory board in Canada is composed of Noah Timmins, Henry Timmins, and John McMartin, while Bewick, Moreing & Co. are general managers. When the Timmins syndicate acquired the Hollinger mine and found a bonanza, they proceeded to acquire claims in the vicinity of the Hollinger and in other parts of the goldfield. Last year the firm of Bewick, Moreing & Co. sent representatives to make an examination of Porcupine, and becoming desirous of acquiring property, they negotiated with the syndicate for a one-half interest in 50 of its claims. Hence the Ontario Porcupine Goldfields Development Co. Supplies and machinery were brought in over the winter roads and two large camps were established, one on the Dunlap claim of the Aitchison group, and one on the Miller claim near the Hollinger. In both places operations are now proceeding actively. The camp on the Miller claim is the headquarters, from which work is now being directed on the Shannon claims, north of Gillies lake. The field management has been placed in charge of Gerald Lovell, assisted by Ernest Williams. In addition Malcolm Maclaren is expected from Australia, to make a thorough geological examination of the goldfield.

It is rumoured that the Porcupine Gold Mines, controlling the Vipond, may receive at least $200,000 for part of this company's holdings in Tisdale. This is the only property in Porcupine that has shipped any gold bars, and is still continuing to do so. Three weeks ago the sixth bar of gold was sent out, of a value of $2000. The west drift on the 100-ft. level of the No. 2 vein has cut the long ore-shoot which has been stripped on the surface for several hundred feet. The cross-cut south of the 100-ft. level to cut the No. 3 vein, which on the surface is wider and richer than the No. 2, has been driven 50 ft. and will probably reach ore within three weeks. A larger mill will shortly be erected; up to the present time two Nissen stamps have been in use.

The West Dome has got up steam, and will begin drilling on another part of the 40-acre lot on which work is now being done. This will make three shot-drills in operation. The third drill will be set up at an angle, so as to hit the vein at a depth of 1000 ft. The shaft, which is on the vein, is now down 70ft., and is progressing rapidly by aid of two air-drills.

A London syndicate, headed by W. Laing Malcolmson, has acquired the property known as the Success. H. Brian Pearson, likewise of London, is consulting engineer, and Ralph A. Mayer has been appointed manager. The property comprises 160 acres, bounded on the west by the Crown Chartered and Vipond, on the north by the Ontario Porcupine Goldfields Development Co., on the east by the Dobie, and on the south by the Dobie and Watson Syndicate. Numerous large quartz orebodies have been found and the management has commenced active prospecting and sampling.

The directors of the Porcupine Power Co. have decided to increase their hydro-electric installation at Sandy Falls by an additional 2000 hp. The original plant, producing 3000 hp., was about finished, and from the progress of the camp in general it was decided to increase the capacity as stated.

The latest rush in the Porcupine area was made this last week to Bristol township, in the Cripple Creek section, where wonderful showings have been discovered on the McCauley claims. Cripple Creek has been before the eyes of the public for some time and, although, taking that country as a whole, free gold showings have not been as extensive as in the real Porcupine area, assays have been much more uniform.

Another interesting locality is the Swastika district, in the township of Otto and midway between Cobalt and Porcupine.

The scourge of mosquitos is particularly bad this year, but they are now at their worst, and in another three weeks it will again be possible to enjoy a day's work in the bush.

PERSONAL

R. S. BOTSFORD has returned from Brazil.

S. E. BRETHERTON has been appointed consulting engineer to the Adaven Mining & Smelting Co. in Nevada.

WALTER L. BROWN has been appointed manager of the Abbontiakoon mine in West Africa.

J. MORROW CAMPBELL is on his way to Tanganyika.

M. H. COOMBE has been appointed manager for the Government Gold Mining Areas, Modderfontein.

FRANK L. COLE and RUSSELL Y. HANLON announce that they have formed a partnership as consulting mining engineers, with offices at Manila, Philippine Islands.

J. H. CURLE sailed for New York on June 30.

ARTHUR DICKINSON left England on June 17 for Norway.

H. SWAN EDGAR has been appointed resident manager of the Carn Brea & Tincroft mines, Cornwall.

MAITLAND EDWARDS is in Turkey.

W. R. FELDTMANN has taken into partnership JAMES A. MACTEAR and H. L. SARGENT. The style of the new firm will be W. R. Feldtmann & Co.

WILLIAM FRECHEVILLE is back from the Transvaal.

WILLIAM HOPE HENDERSON sailed on July 5 for the United States.

C. S. HERZIG, who is making a tour in South America, writes from Manàos, Brazil.

BERNARD W. HOLMAN is at Johannesburg.

E. HOMERSHAM is now manager of the Prestea Block A mine.

J. POWER HUTCHINS has returned from the Ural.

ARTHUR JARMAN, of the Auckland School of Mines, N.Z., has been appointed assistant superintendent of the Waihi Grand Junction.

RONALD JOHNSTONE Jr. has gone to Australia for the British Australian Oil Company.

COURTENAY DE KALB was in Arizona during June.

P. KIRKEGAARD is manager of the North Dome mine at Porcupine.

WILLIAM KNOX has sailed from San Francisco for Vladivostok.

G. W. MACFARLANE has returned from the Gold Coast.

H. F. MARRIOTT has gone to Porcupine.

RALPH A. MEYER has been appointed manager of the Success mine at Porcupine.

C. ALGERNON MOREING and W. J. LORING sailed on July 8 on their way to Porcupine.

PERCY G. MORGAN succeeds J. M. BELL as director of the New Zealand Geological Survey.

F. L. MORRIS is at Dawson.

FRANK J. MURPHY, formerly at Bingham, is now superintendent of the Great Cobar smelter.

B. H. NICHOLSON, manager for the Rayfield Syndicate, has returned from Northern Nigeria.

F. DOUGLAS OSBORNE has left for South Africa to examine a tin placer.

J. C. PICKERING is at Porcupine in the interest of the Exploration Company.

A. J. POLLACK, of San Francisco, spent a few days in London.

C. W. PURINGTON is at St. Petersburg.

JAMES ROBERTS is in the Argentine.

L. D. RICKETTS has been appointed consulting engineer to the Arizona Copper Co. of Edinburgh, and will prepare plans for the re-organization of the reduction plant.

H. N. SCHNURMANN has gone to the Hazaribagh district, Bengal, for a year.

S. F. SHAW was recently at Porcupine.

THOS. B. STEARNS, of Denver, is in London, on a vacation.

RALPH STOKES is expected in London from Johannesburg.

W. F. A. THOMAE is expected shortly on his return from Siam.

SCOTT TURNER did not return to America; he is now in Spitzbergen.

CLAUDE VAUTIN has returned from South America.

H. VINCENT WALLACE is acting as manager for the Mineral Development Co. at Guanajuato.

E. M. WESTON has resigned as lecturer on mining at the South African School of Mines and has left for Rhodesia, where he will act as engineer to the Barnato group.

RICHARD E. WILLIAMS and JAMES A. THOMSON, both of the Waihi mine, are in London.

LEWIS T. WRIGHT has resigned as manager for the Mountain Copper Co. in California.

OLD STUDENTS of the Royal School of Mines are urged to send their addresses to Arthur C. Claudet, 6 Coleman St., London.

RECENT PROGRESS AT MAIKOP

By THEODORE J. HOOVER

THE development of the Maikop oilfield during the first half of 1911 has been marked by three significant events. First, the opening of two fountain wells (on Plot 489) which flowed at the rate of 500,000 poods per day before being capped; second, the opening of another strong fountain well on Plot 490; and third, the completion of the pipe-line from the oilfield to the Vladikafkas railway at Ekaterinodar. This pipe-line opens up a limited market for fuel-oil and refined products on the railway and contiguous territory, and while this market is restricted in area it will consume a constantly increasing amount, sufficient in all likelihood to pay a profit on the investment. The cost of the railway haulage on oil from Ekaterinodar to the seaboard at Novorossisk will probably be prohibitive of any large traffic in this direction and the real outlet to the Maikop district will be by pipe-line to Touapse.

The Maikop Mutual Oil Transport Co. is constructing a line to the port of Touapse; this will be operating before the end of the year. Already three other lines are projected, for one of which the pipes have been ordered. The port of Touapse affords a safe anchorage with 28 ft. of water at the entrance. Further harbour improvements are progressing rapidly, ensuring a large dock-area and deeper water at the entrance. The Touapse pipe-lines will follow closely the line of the Armivir-Touapse railway for most of the way down the valley of the Touapse river. The engineering difficulties of building this pipe-line are considerable, though not insuperable, as was confidently stated in many quarters a year ago. The pumping stations, working directly from the field, will have to work against a pressure of about 950 lb. per square inch; the chief engineering difficulties are those occasioned by the crowding of a railway, a military road, a rapid river, and the pipe lines into the narrow confines of a mountain valley.

Drilling results in the district for the first six months of the year are inconclusive. More than 50 power rigs are at work on wells averaging roughly from 100 to 1000 ft. deep. These wells should all be put down to depths of from 1000 to 2000 ft. The four wells of the Black Sea Oil Fields on Plot 490 are all producing regularly, the well of the Maikop Victory on Plot 489 is producing 50,000 poods per day, and the Maikop Spies has sold some oil from the well on Plot 533.

The oil from all of these wells was sent to market by the Maikop Pipe-line Co. at Ekaterinodar. The well of the Maikop Oil & Petroleum Producers is yielding 12,000 poods per day regularly and the oil is being stored pending connection with a pipe-line and market. This company now has over a million poods of oil stored on the surface. The London and Maikop Oil Corporation well on Plot 411, while producing some oil whenever occasion requires, is hampered by a lack of storage and transport facilities. The Government has also been very slow in arranging for the measurement of oil on this plot, and until these arrangements are made no regular production can take place. This well is the most encouraging development on the Maikop field since the start, as it is at such a distance from the original discovery on plot 490 of the Maikop Oil & Petroleum Producers, and at such greater depth that it probably indicates the existence of at least one other productive pool besides that tapped by the first well. The Maikop Apsheron Oil Co. and the Maikop Areas are both drilling wells near Plot 411, and should strike the same formation at about the same depth as the well on 411, that is, 850 ft. At the Hadijensky end of the field, oil has been struck in paying quantities on Plots 51, 59, and 110, but the wells have not been flowing. The Maikop Premier found oil on Plot 488 at 1385 ft. but the quantity is not known.

Anyone standing on the hills overlooking the Fountain valley is strongly impressed with the visible manifestations of an oil boom. There is growing up under one's eyes an oil city, and at such a speed that it can be seen growing. On the Plots 592, 572, 573, 553, 554, 533, 534, 513, 512, and 490, all of which are either crossed by the river Chakoh or are on the flanks of the valley of that stream and all within the linear extent of less than two miles, the following active companies are operating, in regular order beginning at the east end: The central administration of the Maikop & General Petroleum Trust group in new quarters recently completed, comprising office, manager's house, staff quarters, machine-shop,

stores, and an independent provision and clothing store and restaurant. The companies that have headquarters here are the Maikop Areas, the Maikop Apsheron Oil Co., the Maikop Hadijensky Syndicate, and the parent company, the Maikop and General Petroleum Trust. A few hundred yards up the valley and chaussee road to the west, is the headquarters and main pumping-station of the Maikop Mutual Oil Transport Co. on Plot 573, whence the pipe-line of that company starts through Hadijensky to Touapse, at which latter point are the main offices of this company. The erection of storage reservoirs, buildings, and the necessary machinery on Plot 573 is being rapidly pushed toward completion. A quarter of a mile farther up the road and valley is the auxiliary pumping-station of the Maikop Pipe-line & Transport Co., the main pumping-station of this company being near Hadijensky, 12 miles away. Here also are three large reservoirs. Just across the creek are the offices and headquarters of the Maikop Oil & Petroleum Producers on Plot 53 with staff quarters and three large reservoirs holding 900,000 poods of oil. Next come various small independent shops and bakeries, and then on Plot 533 the offices and headquarters of the Maikop Spies Co. with staff quarters. Next in order is the storage plant of the Anglo-Maikop Corporation on Plot 513, where there is a small oil-pumping plant. Then follows the scene of activity in the vicinity of Plot 490, where the activities of the Maikop Oil & Petroleum Producers, the Black Sea Oilfields, Maikop Enem, British Maikop Co., and others, complete the west end of an active mile and a half. All these newly built structures are interspersed with derricks, small houses, and barracks; the road is crowded with hundreds of teams of horses and oxen loaded with pipe, casing, machinery of all sorts, and provisions. The audible evidence of activity is a babel of tongues in which Russian is dominant, but German, French, Polish, Turkish, Greek, Armenian, and a dozen explosive Caucasian tongues contribute their share; incidentally it may be remarked that English of a violent character appears to be frequent in the vicinity of the many mud-holes. A lusty young town is beginning here! it is now frequently designated as the town of Saltykoffsky, named in honour of Prince I. N. Saltykoff, who in the early days was, and still is, a moving spirit in the development of the oilfield. There should be a post and telegraph office at this place, because more than half the business of the Maikop district is transacted on or near this spot, but owing to the procrastination of those who have these things in hand in Russia, it will probably be some time before such necessary facilities are provided.

Police arrangements in the district are conspicuous by their absence. A highly entertaining chapter could be written on this subject, with brigands in the foreground and inert officials in the background (very far back), but it is perhaps just as well not to dwell on this feature. It should be said, however, that the English companies operating at Maikop owe thanks to their staffs, over and above mere salaries, for the loyal manner in which they have stuck to their posts in the face of trying circumstances. Within the last three weeks the police of the district have for the first time displayed sufficient activity to arrest anyone. After a particularly bad instance of highway robbery, they threw a cordon around the district and stopped everyone for an inspection of passports. As this was an unusual move the result was that a large number of innocent people were detained because they had left their passports at home.

The Armivir-Touapse railway will without doubt be completed to Hadijensky this summer. Hadijensky lies almost at the extreme northern end of what is now considered the Maikop district. There will also be built at least one electric line traversing the whole district longitudinally and connecting with this railway at Hadijensky. The influence of railway connection on the development of the oilfield will be of the utmost importance, and conversely the oilfield will make the railway. The railway will give outlets for oil and access to markets in the productive grain-growing country of Maikop and Armivir.

In general it may be said with candour that the prospects of the field are good in view of only eighteen months development, but investors will of necessity have to curb their impatience for results. The present drilling results are rapidly placing in the hands of engineers data which will enable more intelligent direction of the work than was possible at the inspection. Fully fifty drilling equipments will be at work during the ensuing six months. Two productive areas are known, and the fortunate companies owning land in or near these areas should pay dividends within two years. The question whether oil exists outside of the two territories can only be answered when the present drilling campaign is further advanced.

THE REFORMA MINE

By C. S. THOMAS, Jr.

DURING the last ten years Mexico has been much in the lime-light of the mining stage. The English, who, in the last few decades, have been the leading spirits in the exploitation of the precious metal mining districts, have invaded Mexico systematically and carefully and thereby have reaped a rich reward. Americans, intent on and occupied with the exploitation of their own almost illimitable resources—including a greedy and credulous public—did not spread out much prior to 1900. Since then their mineral resources have undergone limitation and the public having become better educated, they, too, have invaded Mexico, and, to a smaller degree, Canada, until now the combined investments of British and American capital in Mexico amount to nearly two thousand million dollars.

CAMPO MORADO, MEXICO.

Mexico is attracting attention at the present time because of a desultory revolution. The iron hand of Diaz seems to have lost its grasp, although incipient rebellions in the southern parts of the country are crushed suddenly and without mercy. Lively interest in this unrest is occasioned by the fact that any serious depredations might require British or American interference in order to protect the property and lives of foreigners.

In America copper is dominant now. For the last three or four years, in the face of a production increasing faster than consumption, we have witnessed the development and exploitation of the so-called 'porphyry' copper mines: the Utah Copper, Nevada Consolidated, Ray Consolidated, Miami, Inspiration, and Chino. The reserves of these properties, variously estimated at from 400 to 500 millions of tons, are not so great when one considers the huge tonnage that must be mined to make them profitable. We may expect to see them exhausted in about 25 years unless still more ore is developed. In addition, there are possibilities that some of them, while successful, may not come up to expectations in the matter of the costs of exploitation. With a few exceptions all the mining is underground work on flat deposits, and it is likely that even now the best ore is being extracted. I await with hope, but with some misgiving, the outcome of the future low costs in these operations. The Butte mines, the old camps of Arizona, and the Michigan copper belt will not be highly productive after the next 25 years. Therefore we must look to the less exploited countries, such as Africa, Russia, South America, Mexico, and Alaska for our future copper supplies.

The Reforma mine and the district of Campo Morado in which it is situated are likely to prove an important source of copper, together with considerable precious metal. This mine is in Guerrero, Mexico, a region wild and little exploited, and about which little has been written. Copper has been known to exist in this State for many years. The old General, after whom the State was named, at the close of the war following Mexico's revolt from the rule of Spain, paid his soldiers with copper pesos, the metal in them dug from the ground near Campo Morado, smelted crudely and hammered out with the words "8 Reales" stamped upon them.

Campo Morado is at present inaccessible so far as its low-grade ores are concerned and the owners are principally occupied in mining the high-grade oxidized ore, which, in spite of the distance of the property from railway transportation, yields a handsome profit. The mine itself is about 50 miles (80 kilometres) northwest of Balsas, the present terminus of the Mexican Central railroad in Guerrero. It is a rough country, wild, and very sparsely inhabited. The bulk of the population is scattered in small villages and consists mostly of Indians. The mine is reached by rail from Mexico City as far as Balsas; the remaining 80 kilometres may be traversed by floating down the Balsas river in barges to the station of the Reforma Mining Co. at Pezoapan. Thence it is a 30 kilometre ride on horseback to the mine.

The Balsas river is one of the large streams of Mexico, for even in the dry season it boasts a large flow of water. At the time of my trip the rainy season was just beginning and the water was high and running swiftly. The river has its source in the mountains of Puebla and Oaxaca and evidently it serves as a powerful agent of erosion. During the rainy season the water contains about 15% of sand and silt. The prevailing rocks of the watershed are so soft as to cause great difficulty in the proper maintenance of power sites. There are an average of about two rapids per mile. The drop in elevation from Balsas to Pezoapan is from 500 metres to 460 metres in a distance of 80 kilometres.

The return trip is made on horseback. The general country is steep, but not rugged. Although the slopes of the mountains are smooth and well covered with the products of erosion the vegetation is comparatively scant. Timber large enough for mine use is scarce.

The prevailing rocks are shale, slate, and limestone, of the Lower Cretaceous. These beds are seen in the canyon of the Balsas almost always dipping steeply, giving evidence of extraordinary and probably profound movement. Occasional intrusive bodies, generally sills between the sedimentaries, appear. On the road from Pezoapan to Campo Morado a large dike of a coarse grained porphyry was observed crossing the strata for several miles.

At the Reforma a large body of grano-diorite has intruded itself and forms the hanging wall of the vein, which cuts across a mountain with very steep sides and a sharp ridge. It is developed by six tunnels running entirely through the mountain and driven in the foot-wall of the vein. Frequent cross-cuts expose a width of lode averaging 100 feet. The lowest tunnel, some 700 ft. below the top of the pyrite orebody, shows a length of about 2000 ft. of solid pyrite. The oxidized ores follow the profile of the hill along the top of the pyrite and have an average depth of 200 to 300 ft. The transition from completely oxidized ore to sulphide is most abrupt. This is due to the even grade of the ore and its uniform texture. In the process of oxidation the metallic contents were leached and deposited on the foot-wall side of the vein, against the top of the pyrite orebody. The residuum then crumbled and formed a layer of low-grade sand. The volume of space occupied by the vein was considerably decreased after oxidation and the hanging wall collapsed, forming a layer of loose rock and dirt over the sand. Such a condition makes the ground heavy and requires careful work to prevent caving. Only the oxidized ore is being mined at present; it will average about 25 to 30% Fe_2O_3, 25 to 30% SiO_2, 8 to 15% Pb, besides gold and silver. The ordinary run of ore has an assay-value of from $50 to $100 per ton.

The pyrite orebody is immense and, of course, constitutes the bulk of the ore in the mine. It is practically a solid mass of sulphide containing small quantities of copper, zinc, and lead, with a little gold and silver. It is a little richer in copper on the foot-wall side for a width of about 20 ft. than on the hanging-wall side. The grano-diorite of the hanging-wall was evidently the medium through which the original fissure was made. This fissure was probably wide, 100 to 150 ft., and involved a complete shattering of the slate for the entire width of the fissured zone. The vein is a replacement deposit in a wide fissured zone. This is evident from the regularity of the walls. The slate is somewhat carbonaceous, thus affording an excellent precipitant for the metals in the thermal solutions.

The assay-value of the pyrite, with the exception of the slightly richer foot-wall streak, is most regular. Samples for 10 feet and from

THE REFORMA SMELTER.

HAULING WATER-JACKETS TO THE FURNACES.

125 to 150 pounds each, often do not show a variation in value of more than 5 to 10%. There are developed above the sixth level a little over 9,000,000 tons of pyrite ore containing 4 oz. silver, 0·08 oz. gold, and 1·52% copper per ton This ore carries an average of 38% iron and 42% sulphur, it is practically solid pyrite.

In addition to the main Reforma lode there is another parallel vein, smaller but similar in character. Thus far the ore in this vein, known as El Naranjo, has only been developed on the west side of the hill. The main pyrite erebody in the Naranjo has been developed on three levels. Samples taken on the two upper levels averaged respectively 2·75 oz. silver, 0·34 oz. gold, 4·7% copper, and 14·50 oz. silver, 0·108 oz. gold, 1·58% copper.

Besides these two orebodies, the Reforma and the Naranjo, there has been opened up, in a cross-cut from the Reforma, another known as the Mamey. It is only cut in one place, however, so that little is known about it as yet.

The oxidized ore is mined by a sort of gophering caving system. The openings underground are kept as small as is consistent with getting the ore out. About 60 tons per day is mined and treated in a smelter having two 36 by 60in.· water-jacketed blast-furnaces and three 4 by 5 ft. English cupelling furnaces. Some of the lead bullion, that running over

	Reforma.			Mt. Lyell.					
Lead	Tr.	Tr.	Tr.	Tr.	...	—	0·65	0·70	0·89
Copper	1·5	2·65	1·58	4·70	...	2·35	0·73	0·75	0·60
Iron	34·80	39·80	38·20	40·10	...	40·30	42·02	44·76	39·88
Lime	0·60	Tr.	·60	Tr.	...	—	—	—	—
Insoluble	16·50	7·00	12·00	1·60	...	8·96	4·09	2·00	6·38
Sulphur	34·80	44·10	39·50	46·80	...	46·50	48·77	44·76	46·60
Zinc	3·80	3·30	3·70	3·70	...	—	1·30	1·50	2·10
Arsenic	—	—	—	—	...	—	0·30	0·23	—
Silver oz.	4·11	5.19	4·97	8·25	...	2·00	1·50	1·12	1·74
Gold, oz.	0·08	0·09	0·08	0·11	...	0·07	0·07	·08	0·06

2% in precious metals, is cupelled and the gold and silver extracted. The lower grade bullion is packed on mules, two bars to an animal.

All supplies are brought by rail to Balsas, where they are transhipped to barges made of native timber. These barges have a capacity of four tons each. They are manned by a crew of four natives, who steer them as they float down the river and drag them back on the return trip. The trip down requires 1 day and the return trip from 3 to 4 days. At Pezoapan the supplies are unloaded and taken to the mine on mules and donkeys. The cost of the supplies is high because of the number of times they have to be transhipped and because of the distances they have to be packed. The cost of coke at the mine is particularly high on account of the loss by abrasion. Some supplies have to be packed from Balsas to the mine because the packers who take the bullion out must have some return freight. The cost of the principal supplies is as follows, in United States currency:

Posts, 7 ft. long, oak	$0.37
Caps, 5 ft. long, oak	0·25
Lagging, 6 ft. long, oak	0·07
Charcoal, per ton	7·00
Coke, per ton, Mexico City.	11·00
Coke, per ton, Balsas	15·36
Coke, per ton, Reforma mine	28·00
Mine bosses, per day	1·00
Miners, per day	0·75
Labourers, per day	0·50

Detailed accounts have not been kept but, taking the total charge for 6 months at $67,289·51 and the tons mined at 7940, the cost is $8·48 per ton for mining and smelting. Refining charges and freight are $6·05 and metallurgical losses about $8·50, making a total of $23·03 per ton. These costs, however, cover every charge and include all construction work, besides development.

The pyrite ores of the Reforma are almost identical in composition with those of Mt. Lyell in Tasmania, and could be mined and treated in the same way. Analyses may be compared thus:

The future plans for the mine, dependent on the construction of the railroad from Balsas to Pezoapan and the construction of either a narrow-gauge railroad or an aerial tram from the mine to Pezoapan, involve the development of power in the Balsas river and the erection of a pyritic smelting plant of about 1500 tons daily capacity. These plans are entirely feasible, and when carried out, should place the mine in the ranks of the big mines of the world. The average value of some 11,000,000 tons of developed ore is $7·53 per ton, and working costs should not exceed $4·50 per ton. The railroad from Balsas to Pezoapan has been surveyed and a subsidy of 7500 pesos per kilometre has been offered by the State and Federal governments.

METALLURGY AT THE GLOBE & PHŒNIX

By H. T. BRETT.

THE Globe & Phœnix mine is so well known as the premier gold producer of Rhodesia that it is not necessary for me to give its history; suffice it to say that the Globe is not now being worked and that the Phœnix suddenly acquired fame when an enrichment was found extending several hundred feet above and below a horizontal dike at a vertical depth of 1700 ft. The increase in the value of the ore may be gauged by the fact that the reserve at the end of 1910 was 178,221 tons averaging 33·9 dwt. per ton, as compared with 106,155 tons averaging 11 dwt. at the close of 1907. This ore contains sufficient antimony in the form of stibnite to make its treatment difficult both as regards cost and recovery. Much time and money have been spent in studying the question, and as the new plant is giving good results, I feel that the publication of details will be helpful to others confronted with a similar problem. It is not claimed that the method now adopted is in the nature of a new departure in metallurgy, but rather a combination of known processes applied to suit local conditions.

The ore is a hard white quartz, and, as the following analysis shows, with the exception of antimony, is singularly free from base metals:

	%
Silica and insoluble	76·32
Antimony	0·73
Iron	2·58
Sulphur	0·91
Lime (CaO)	1·21
Magnesia (MgO)	6·44
Arsenic	Trace
Copper	Trace
Gold	32 dwt. per ton.
Silver	3 dwt. per ton.

The stibnite is found in irregular patches throughout the mine, at some places fairly massive and free from gold, and at others intimately mixed with the quartz. In the rich ore (3 oz. gold per ton and over) the proportion of stibnite increases up to 3% and the pyrite is high in gold. Generally about 75% of the gold is free and recoverable by amalgamation; a considerable proportion of the 'rusty' or 'coated' gold is not caught on the plates but can be recovered in grinding-pans.

An ore low both in antimony and gold presents a hopeless problem unless the gold can be liberated and caught by fine grinding. The antimony has an injurious effect on cyanidation owing to its easy solubility in alkaline solutions and its property of robbing the cyanide of the oxygen required. An example of this can be given in the case of the ore under discussion where, in cyaniding sand and slime with everything conducive to a good extraction, the presence of only 1% stibnite makes an extraction of more than 20% of the gold practically hopeless. The concentration of antimonial gold ore is also difficult owing to the tendency of antimony to slime. In the present instance the question was further complicated by the fact that a reduction plant was already in operation at the mine, and, on ore assaying up to 12 dwt. gold per ton, was giving good results. Moreover, the surface space available was so limited as to preclude a radical re-arrangement of the plant. The prospects of the rich ore continuing had to be carefully considered, and the position in June 1909, when experiments commenced, made it necessary for a metallurgist to proceed with caution. Fortunately the ore has proved persistent and a further extension of plant will probably be made.

The original plant, erected ten years ago, was designed on the lines usual when dealing with a free-milling ore and consisted of a 40-stamp mill, a cyanide leaching plant, and a slime decantation plant. The presence of antimony soon began to make itself felt, and in the sand and slime plant the extraction dropped to 40% and 30% respectively. It was discovered, however, that if the slime was run direct, without treatment, to dams, and stored there for about six months, and allowed to 'weather,' or oxidize, and then broken up and pumped to the slime plant, the extraction was raised to 75 or 80%. This course was henceforth adopted as far as the slime was concerned, and it was naturally imagined that the same result would ensue as regards the sand. But extended trials proved otherwise. After a close investigation of the sand then being treated, it was found that the antimony and pyrite were in a much coarser state than in the slime; moreover, the operation of the sand-plant was handicapped by the presence of coarse particles of ore due to broken screens.

Finally 'rusty' coarse gold was beginning to appear, and as there were then no grinding appliances to save it, a further loss in the sand-residue was inevitable. Numerous experiments were made in aeration, length of treatment, and fine grinding and amalgamation, but all with unsatisfactory results, although the last mentioned method proved encouraging. An endeavour was then made by the erection of two grinding-pans in the mill to re-grind the coarsest of the sand, and, by the additional installation of sorting-belts and jigs, to eliminate as much antimony as possible before the ore reached the stamps. The pans did fairly good work as far as saving of the coated gold was concerned, but were found insufficient in number to cope with all the coarse sand, while the sorting and jigging department (owing to the tendency of antimony to shatter into minute fragments) prove disappointing.

The extraction obtained by treating 74,492 tons during the year 1909 was:

	Extraction Dwt. per ton	Percentage of content extracted
Extracted in mill	15·92	75·66
„ from sand	1·17	5·56
„ from slime partly weathered	0·76	3·61
„ total	17·85	84·83
Left in sand-residue	2·77	13·17
Left in slime-residue partly weathered	0·42	2·00
Original assay of ore	21·04	100·00

The extraction of 84·83% for the year 1909 is not alarmingly low, but occasionally when the mill for several days was engaged in crushing development-ore from the enrichment close to the dike, with a pulp assaying from 60 to 100 dwt. gold per ton, the extraction dropped (because of the antimony) to about 75%, leaving a residue containing about 15 dwt. As the reserve of rich ore had increased, the management decided to take steps to improve the extraction. In doing so the following points had to be remembered:

(1) That a plant already existed at the mine.
(2) That about 75% of the gold content could be obtained by amalgamating and grinding.
(3) That a good extraction could be obtained on slime up to 6 dwt. by storing in dams and weathering for about 6 months before cyanide treatment.
(4) That advantage must be taken of the brittleness of the antimony to grind the sand finely, and so force the antimony into the slime, where, by weathering, it would be rendered harmless. The fine sand remaining to be leached would then have but little antimony left to interfere with its treatment.
(5) That the ore reserve in the mine was increasing in value.

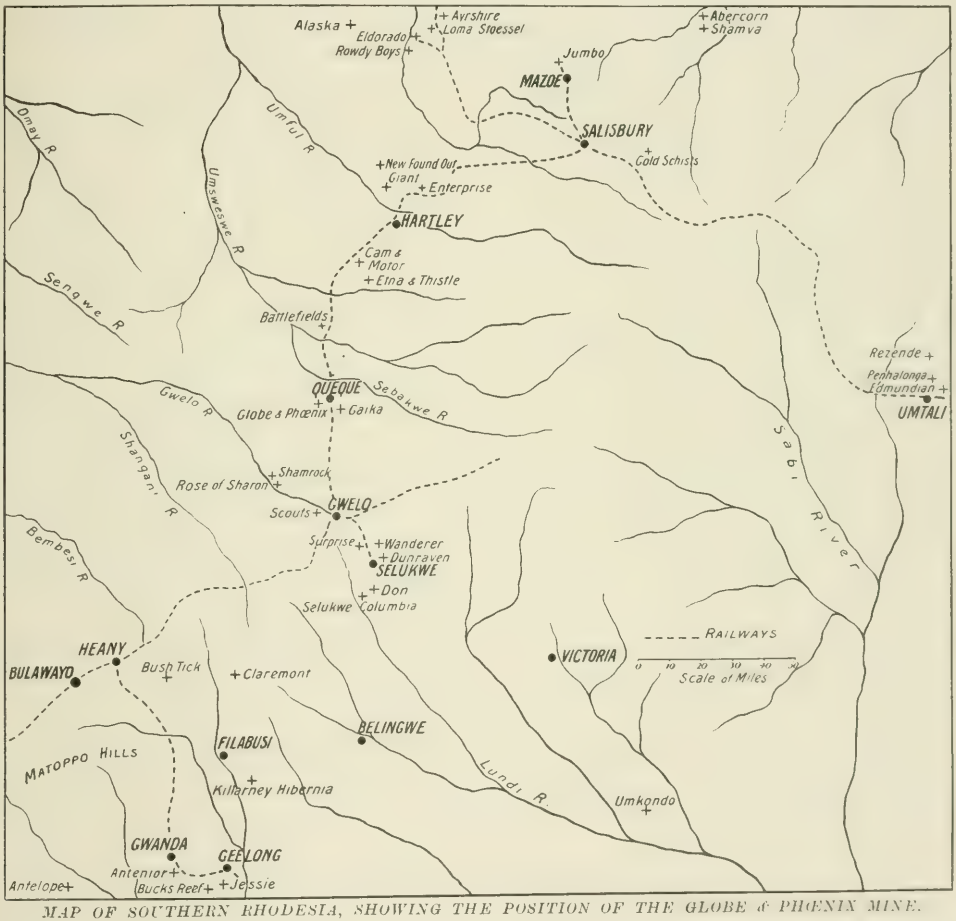
To make the experiments on a large scale 10 stamps were set apart, with 2 grinding-pans followed by Wilfley and canvas tables. Trials were made on ore assaying from 11 to 25 dwt. per ton. In all cases the results showed an extraction of over 90%, in fact, on ore up to 15 dwt., the sand caught after fine grinding was of so low a value that cyaniding was unprofitable. The conjecture that finer grinding would drive most of the antimony into the slime proved correct, while the slime (50% of the tonnage milled) invariably had an original value about 50% higher than the sand, and as the slime by exposure to the atmosphere proved amenable to cyanidation a big advance was made in the successful solution of the problem.

All-roasting of the ore also gave good results. If the ore increased greatly in value this process would probably have proved the best, but its adoption meant a dislocation of existing arrangements, besides a large capital outlay.

Armed with the experience thus furnished, the alterations were commenced early in 1910 and the full plant was running in December of the same year. The ore is now trammed to the crusher-house, to fall on grizzlies with bars placed 2 in. apart. The fine passes into a storage-bin; the oversize is partly shovelled and partly runs into two 15 by 9 in. Blake-Marsden crushers, and thence falls into another bin. This bin has iron doors discharging to an 18-in. belt-conveyor, which takes it to a washing-trommel. This trommel is 10 ft. 6 in. long by 5 ft. 6 in. diam. at the large and 2 ft. 9 in. at the smaller end, perforated with $1\frac{1}{2}$ in. holes for the first four feet of its length and $\frac{1}{4}$ in. holes for the remainder, and revolves at 18 r.p.m. The fine drops through the $1\frac{1}{2}$ in. holes to another 18 in. belt-conveyor, while the oversize passes along the trommel and, after being washed, to a 33 in. sorting-belt travelling at 100 ft. per min., allowing part of the massive stibnite ($\frac{1}{2}$ ton to 1 ton per day) to be picked and stored pending further treatment. This sorting-belt delivers the ore to the same belt as the fine from the trommel,

and is conveyed to mill-bins having a capacity of 500 tons. The ore is distributed in these bins by means of two 18 in. shuttle-belts delivering into two revolving chutes. The mill consists of 40 stamps, each of 1250 lb., and has been in use now for ten years. Each stamp drops 102 times per minute and crushes $5\frac{1}{2}$ tons per day through a 25-mesh screen, followed by the usual amalgamated copper-plate table. Three feet of the bottom end of the table is covered with a blanket to catch the coarse particles of 'rusty' gold that refuse to amalgamate. This product is afterward amalgamated in a barrel. The tailing, on leaving the plates, runs into classifiers each 36 by 36 by 30 in. (one to each 10 stamps) where the slime is separated, while all the sand passes to 6 Record vanners (5 in use and 1 spare). Concentrators were installed to extract as much of the antimony and pyrite as possible, and also to act as a check in case any sudden addition of rich ore might raise the value of the tailing unduly. The concentrators precede the re-grinding plant, as the antimony is saved easiest when in coarse particles. It was also deemed advisable to impoverish the slime passing to the storage dams for weathering.

The fine slime overflowing the classifiers passes direct to the blanket-tables, while the sand goes to the vanners. The antimony and pyrite, containing about 70% of silica and other insoluble matter, pass from the tables to launders with a steep incline to a Frenier pump, by which they are elevated about 16 ft., and run to two settling-tanks at the concentrate-roasting plant. The tailing from the vanners then passes into 10 grinding-and-amalgamating pans running at 55 r.p.m. These pans require about 8 hp. per pan and treat 160 tons per day. The fine pulp from the pans, together with the overflow of the classifiers at the head of the vanners, passes over a blanket-table 58 ft. wide by 38 ft. long



MAP OF SOUTHERN RHODESIA, SHOWING THE POSITION OF THE GLOBE & PHŒNIX MINE.

divided into strakes each 24 in. wide. The blankets are removed at regular intervals and washed in pointed boxes. The fine concentrate from these boxes runs into the same Frenier pump as the concentrate from the vanners, and is pumped to the roasting-plant. The pulp now finally leaves the mill building and flows to the sump of the tailing-pump.

The following figures, taken over a week's run, illustrate the extraction obtained. In crushing such rich ore it is difficult to prevent violent oscillations in the grade (varying from 20 dwt. to 60 dwt. per ton) with corresponding variations in the value of the sand-residue.

EXTRACTION IN MILL AND ACCESSORIES.

	Gold Dwt.	Stibnite %	Pyrite %
Screen discharge	36·0	1·02	1·69
Leaving plates	15·0		
Slime overflow from classifiers (20% total tonnage)	12·0	2·02	2·30
Sand from classifiers (80% of total tonnage)	16·0	0·76	0·86
Sand leaving vanners and entering pans	11·25	0·17	0·54
Pulp leaving pans	6·25		
Pulp from pans running on blanket-table and slime from classifiers	6·50	0·67	1·20
Pulp leaving blanket-tables and entering cyanide plant	6·00	0·51	1·10
Total percentage extraction	83·50	50·00	35·00
Sand caught in sand-collectors, 50% of mill-tailing	4·5	0·4	0·85
Slime run to dams for weathering and subsequent treating	8·5	0·75	1·36

SIZING RESULTS.

	Mesh Used. +40 %	+60 %	+100 %	+150 %	−150 %
Battery-screening	23·4	18·3	22·4	10·4	25·5
Feed to pans	32·8	20·6	25·0	7·6	14·0
Discharge from pans	0·2	1·6	34·2	19·8	42·2
Pulp leaving mill	0·1	1·0	17·8	15·4	65·7
Sand in collectors	0·1	0·8	24·2	29·2	45·7
Slime to dams	Nil	Nil	Nil	2·3	97·7

The pulp finally leaving the mill flows to a Forwood-Down pump. A tailing-wheel had been in use for ten years, but as the alterations necessitated a much higher elevation of the pulp, and space being limited, a pump was installed. After being elevated 51 ft. by the tailing-pump the pulp flows down a launder to a large spitzkasten 61 by 6 by 6 ft. where the fine sand is separated for the sand-collectors, while the slimy water overflows to the slime-collectors. The sand-collectors consist of 4 steel tanks, each 30 ft. diam. by 7 ft. deep, superimposed over 4 steel leaching-tanks, 30 ft. diam. by 8 ft. deep. The sand produced is about 50% of the tonnage milled, and owing to its fineness the collectors are only filled to a depth of 6 ft., each charge being subjected to about six to eight days actual treatment in the lower tanks. Sizing tests of the sand show :

Mesh	%
+ 40	0·1
+ 60	0·8
+ 100	24·2
+ 150	29·2
− 150	45·7
	100·0

As already mentioned the extraction on the sand had been unsatisfactory, and even after the alterations the residue from high-grade ore (over 30 dwt.) is too valuable to be rejected. Numerous attempts have been made to reduce the sand-residue to an economic limit; for instance, several tons were exposed to the action of the atmosphere for months but with an indifferent result. The largest loss is in the *minus* 150 product, which contains practically all the fine antimony and pyrite.

As before and after the alteration of the plant it had been found necessary to crush rich ore on various occasions, the schedule at the top of the next page is interesting.

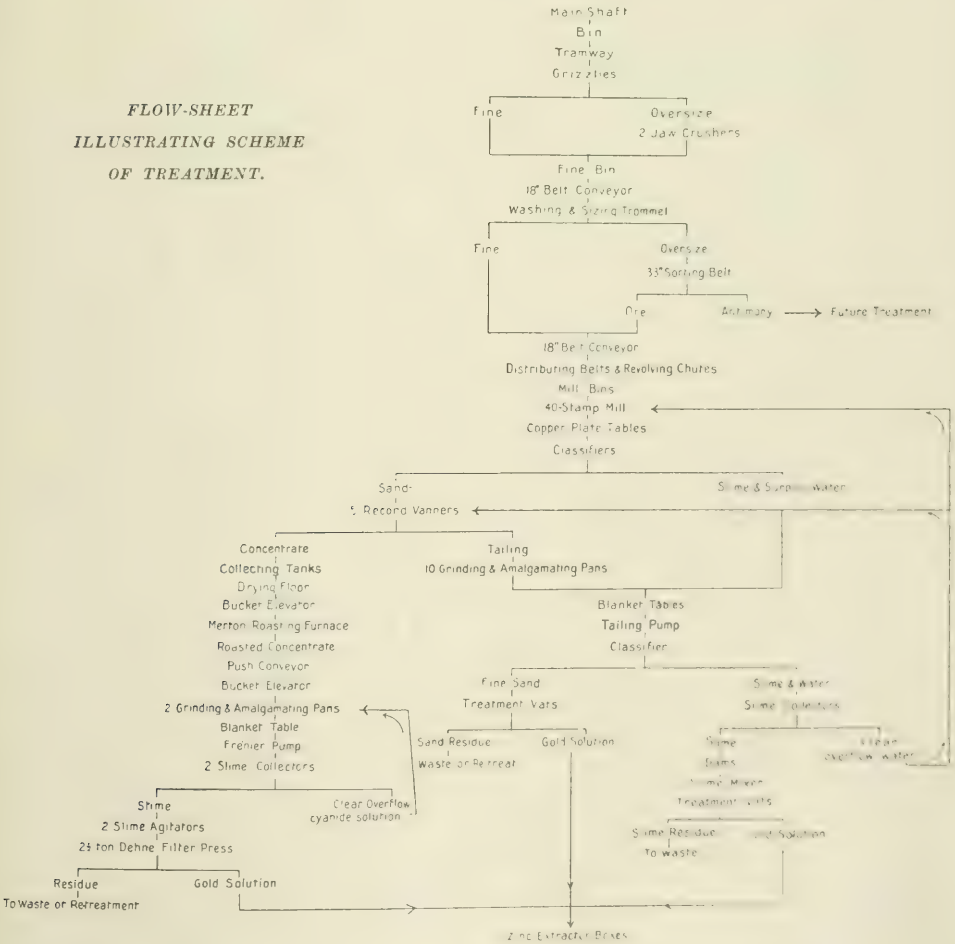
It will be observed that as soon as the antimony in the sand charge exceeds (on high-grade ore) 0·2%, the extraction drops rapidly. As before the alteration to the plant the sand treated constituted 80% of the tonnage milled, as against only 50% at the present time, the general loss in residue per ton milled is now obviously much lower in proportion than the above figures indicate.

The overflow of slime and water from the large spitzkasten placed over the sand-tanks goes to two 35 by 14 by 17½ ft. collectors where the clear water is drawn off and pumped back to the mill-supply tank, while the thick slime is drawn from the bottom and pumped to the storage-dams. As soon as the accumulation has attained a thickness of about 6 ft. and contains about 10,000 tons of dry slime, the stream of thick untreated current is turned into another empty dam and so on. At the

Results on Rich Ore.

Battery Screening Dwt.	Antimony in sand %	Before Alterations			After Alterations		
		Sand Charge Dwt.	Sand Residue Dwt.	Gold Extracted %	Sand Charge Dwt.	Sand Residue Dwt.	Gold Extracted %
15	0·1	4·0	2·5	37·5	1·5	·50	66·6
17	0·1	5·5	3·5	36·3	2·0	·75	62·5
20	0·15	6·0	3·75	37·5	2·5	1·00	60·0
25	0·20	8·0	5·00	37·5	3·7	1·50	60·0
30	0·26	10·0	7·00	30·0	4·5	2·0	55·5
40	0·42	12·0	9·50	27·7	5·7	3·50	38·6
60	0·60	17·0	12·00	29·4	7·5	5·00	33·3
80	0·81	20·0	16·00	20·0	8·75	6·50	25·7
100	1·10	25·0	20·00	20·0	12·00	8·50	29·1

FLOW-SHEET ILLUSTRATING SCHEME OF TREATMENT.



end of two months of dry weather the surface of a dam is solid enough to permit of its being ploughed to a depth of about a foot, and after a further week, this ploughed portion is harrowed and allowed to stand for another month or so, or until the loose slime appears perfectly dry and oxidized. The slime is then shovelled into trucks and goes to a mixer. To permit of continuous weathering of the slime before cyanidation, it is necessary that several dams be in use at once, so that one is being filled, one is drying, and two are being ploughed and harrowed.

The mixing of the slime is done in a steel tank, 4 ft. diam. by 3 ft. 6 in. deep, in which is placed a steel cone with the large end rivetted to the top edge of the tank, while the apex of the cone has an opening of about 18 in. diam. and reaches to within 12 in. of the bottom of the tank. In this opening revolves, at a speed of 200 r.p.m., a four-bladed propeller connected to vertical shafting and driven by means of pinion and spur-wheel gearing. The slime has to pass the blades of the propeller and is then forced up between the side of the cone and tank, passing out of a 6 in. opening in the side of the latter. Cyanide solution is added to the mixer to make a pulp of about $1\frac{1}{2}$ parts of solution to 1 of slime. The pulp on leaving runs into a tank or steady-head, connected to the suction of a double-acting centrifugal pump, which elevates the pulp into the decantation plant. The capacity of the mixer itself is about 12 to 15 tons of dry slime per hour, and 20 hp. is required to operate the entire apparatus. The plant for the actual cyaniding was erected about 5 years ago and is of the usual decantation type, consisting of two collectors 35 by 14 by $17\frac{1}{2}$ ft., six treatment tanks, also 35 by 14 by $17\frac{1}{2}$ ft., three clarifying tanks 20 by 5 ft., with pipe connections, and centrifugal pumps for transfer of slime and decantation of solution into clarifiers and sumps. This plant has a capacity of about 3000 tons of slime per month of an original value of 4 dwt. per ton, but when richer material is treated the capacity will be less. To obviate this the erection of a vacuum-filter plant is under consideration. The total cost of treating slime is 3s. 6d. per ton.

The extraction obtained on weathered slime of a value of 4 dwt. is from 75 to 80%, while on the same slime if taken direct from the mill the extraction drops to about 30%. For an extra expenditure of 6d. per ton therefore in the handling and weathering of slime in the dams, a further extraction of 45% is effected.

The concentrate from the vanners and blanket-tables is elevated by means of a Frenier pump into two small collecting-tanks 12 ft. diam. by 4 ft. deep, provided with filter-bottoms, and an overflow launder round the periphery, which takes the clear water and delivers into the sump of the tailing-pump. The concentrate collected each day is allowed to drain, and then shovelled upon a sloping floor to dry for 24 hours and thence fed by means of a chain-and-bucket elevator into the top hearth of the roasting-furnace. This is a Merton 3-hearth furnace with a finishing hearth-extension. On each hearth are four solid knife-edge rabbles, while the finishing hearth has three water-cooled rabbles with diamond-pointed feet. All the rabbles run at two revolutions per minute.

The successful treatment of an antimonial gold concentrate is always difficult. Various experiments on the raw concentrate gave extremely poor results, but roasting experiments held out a much better prospect, especially when compared with the only other course open, namely, bagging and shipment. When an ore or concentrate containing antimony is roasted, the volatile trioxide is first formed, which on coming into contact with air forms the infusible and stable tetroxide. Again, when antimony or stibnite is roasted in presence of the sulphides of other metals, antimoniates of these metals are formed. It is therefore impossible to get rid of all the antimony, while it is also found that, when a large percentage of this substance is present, the ore on heating swells considerably and becomes 'sticky.' These difficulties can be partly overcome by constant rabbling in the presence of a large proportion of sand or silica. Trials showed that 90% could be recovered, and it was hoped that by exposing the residue to the atmosphere in dumps from six to twelve months, and running it through the large decantation slime-plant, this extraction could be raised to at least 95%. The total cost of the treatment of the concentrate on a large scale was estimated to be about 25s. per ton. These figures have been borne out in practice; a comparison with bagging and shipping to England, freight alone costing £6 per ton, emphasizes the advantage of roasting the concentrate at the mine.

The roasted product is discharged into a push-conveyor, 30 ft. long with flights 12 in. wide running at 18 strokes per minute; this cools and conveys it to a small chain-and-bucket elevator, which delivers it to two 5 ft. grinding-and-amalgamating pans, running at 45 r.p.m., in which cyanide solution is used.

After grinding, the pulp flows from the pans over blanket-tables (which catch any fine 'rusty' gold or 'flowered' mercury), thence into a Frenier pump, to be elevated 18 ft. to a classifier, which returns any oversize back to the pans, while the overflow passes into two 16 by 6 ft. collectors provided with overflow launders. The overflow clear solution gravitates to a storage-tank supplying the pans, while the slime settles to the bottom and is discharged every 24 hours into two 16 by 6 ft. tanks having agitators running at 14 r.p.m. After 24 hours agitation, a three-throw pump forces the pulp into a 2½ ton Dehne filter-press, where the gold solution is removed and the cake washed and discharged (containing about 12% moisture) into trucks, and dumped for oxidation and future treatment if the gold contents warrant. The capacity of the furnace is about 11 tons per day (depending on the proportion of antimony and sulphur present) while the capacity of the remainder of the plant is double this, so, in the event of any increase in output, the addition of another furnace only would mean that 600 tons of concentrate per month could be roasted, slimed, and cyanided. The whole of the floor around the pans and furnace and under the filter-press is cemented, so as to minimize loss of gold in solution or dust.

An analysis of the raw concentrate shows about 65% silica and insolubles, 5% antimony, and 9% sulphur, while the roasted product is found to contain 3% antimony (chiefly as antimoniate) and 0·72% sulphur (0·6% existing as sulphate and 0·12% sulphide). It will be noticed that while a good roast as regards the expulsion of sulphur is obtainable, the antimony is not so readily driven off. The loss in weight in roasting varies between 25 and 30%, depending on the quantity of sulphur in the raw concentrate. The gold in the concentrate varies between 2 and 15 oz. per ton, and in the residue for 2½ to 25 dwt. per ton. The extraction has ranged between 85 and 90% and an experiment on the roasted residue exposed for only three months to the atmosphere indicates a further extraction. The firing of the furnace is done with wood by native firemen, one white man per shift being in charge of the whole roasting-plant, although the same man could easily superintend the working of two more furnaces. The total labour is 3 white men and 15 natives per 24 hours. The running time is about 94% of the possible, and so far the repairs on the whole roasting unit have been extremely small. The cost on a basis of 320 tons per month is as follows:

	Per ton. s.	d.
White and native labour	10	0·26
Fuel for roasting	2	1·71
Cyanide	3	3·46
Power (including compressed air)	3	9·58
Assays, etc.	1	5·09
General stores (zinc, acid, filter-cloth, oil, etc.)	2	2·10
Total	22	10·20

With the addition of an extra roasting-furnace, it is anticipated that on 600 tons of concentrate per month, the total cost would be reduced to 17s. 6d. per ton.

It has been found that the concentrate requires to be brought to a high temperature very slowly, and as the knife-edge rabbles are rather against this, steps are being taken to change most of them for the solid rabbles with diamond-pointed feet.

About 60% of the gold is obtained by amalgamation in the pans and 40% by cyanide. The gold from both processes is melted into one bar, about 965 fine.

As the new plant has been in full operation about three months at the time of writing, sufficient data are available to estimate the average extraction, although, owing to the storage in dams of the slime for six months, the total extraction, including that on the actual slime produced each month, cannot be given. As thousands of tons of weathered slime have been treated, it is an easy matter to calculate the recovery as if the slime actually produced in any one month had been treated during that period.

Taking January last as an example, during which 6539 tons was milled, the estimated extraction was as follows (allowing 80% recovery on the slime, which would be the result after six months lying exposed to the air):

Source.	Dwt. per ton milled.	Percentage per ton milled.
Stamps and pans	28·94	79·86
Concentrate	2·41	6·65
Sand	0·39	1·08
Slime	2·15	5·91
Total extracted	33·89	93·50
Concentrate-residue	0·21	0·59
Sand-residue	1·60	1·49
Slime-residue	0·54	4·42
	36·24	100·00

The actual figures for January were an ex-

traction of 91·31% on an original assay-value of 35·29 dwt. The discrepancy in these figures and those given in the above schedule is due, as stated, to the fact that the weathered slime from the dams during the month was only about half the value of the actual slime produced.

WORKING COST.

	s.	d.	s.	d.
Mining	6	10·17		
Development	4	0·00		
Hauling and pumping	3	0·71		
			13	10·88
Transport and rock-breaking	1	1		
Milling (inclusive of fine grinding and concentrating)	6	6		
Sand treatment	1	9·40		
Slime treatment	1	7·26		
Concentrate treatment	1	1·15		
General repairs and maintenance		9·11		
Bank charges on bullion		4·94		
			13	2·86
General administration			2	9.33
Total cost			29	11·07

As the sand-residue yields an unsatisfactory extraction on the high-grade ore, future improvements will be required. One proposal is to eliminate the sand-plant altogether, grind the sand in tube-mills, and convey it together with the present slime to dams, for weathering. Against this, there is the question of surface room, as a large space is now appropriated in exposing to the air the present slime (3000 tons per month) and to increase this to 6000 tons per month necessitates double the dam-area. The question of native labour (always a scarce commodity), in attending to the dams, affects the decision; there is also the question whether this sand can be slimed and in six months oxidize sufficiently to become amenable to cyanidation. As six months must elapse before this question can be ascertained (exposure to the atmosphere being the essential factor, not to be accelerated by any artificial means), it is obvious that if at the end of that time results are unsatisfactory, the position becomes awkward and a fairly large capital outlay is undertaken for no result. Another suggestion is to erect a roasting-furnace of 100 tons capacity, together with necessary pans and tube-mills, take the sand direct from the collectors and roast, slime, and cyanide it. This scheme would be a little more expensive than that just mentioned, but it is more certain of success as far as gold extraction is concerned.

It is suggested now to erect three large roasting-furnaces, the necessary pans, tube-mills, and filter-plant, cut out the present sand-cyanide plant (except the collectors), roast, slime, and cyanide 200 tons of old accumulated sand together with 100 tons of current sand, or a total of 300 tons per day. The cost of treatment is not expected to exceed 8s. with a loss of gold in the residue of under 3s. per ton. The whole question is a matter of profit per ton and capital expenditure involved, with due regard to local conditions, and should the last named proposal be finally adopted—roasting the whole of the old accumulated and current sand—it must be admitted that it will be a unique undertaking.

Carn Brea and Tincroft.—The latest news of interest from Cornwall relates to the rearrangement of the directorate and management of the Carn Brea and Tincroft at Camborne. For some years Viscount Clifden, one of the lords, has taken a more direct and intelligent interest in mining operations than is usual with the owners of mineral rights. Not only has he foregone royalties but he has subscribed capital. Six months ago, when it was decided to separate the tin and wolfram, he provided the money for the Wetherill plant. The recent death of the manager, John Penhall, gave him the opportunity of pressing on the board of directors the necessity of introducing new blood, and appointing a man of wider experience than the average mine captain obtainable nowadays locally, and accordingly Edward S. King, who has an honourable record in Australia, was selected as 'consulting manager' with H. Swan Edgar as resident manager. The old system of buying supplies was discarded and in future the requirements are to be advertised in public competition. Frank Harvey and J. C. Daubuz, who have been on the board for many years, have retired and Lord Clifden is virtually the controller. There is no doubt that the mine has sufficient reserve of ore to last for some time, and with the improved prices obtainable consequent on the better separation now possible and with the decreased cost following on reduction in the price of supplies, some profits should be made in the near future. In the meantime Mr. King will have time to turn round and evolve new schemes for development and treatment.

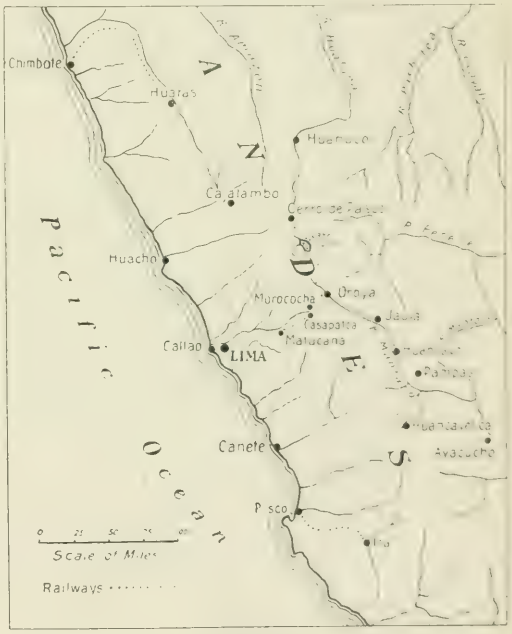
THE CASAPALCA SMELTER, PERU

By LESTER W. STRAUSS.

THE Casapalca smelter is the second largest metallurgical establishment in Peru and though overshadowed by the gigantic Cerro de Pasco it plays an important part in the development of the mineral resources of that country. It was originally established in 1888 for the treatment of silver-bearing lead ores, and was founded by Jacob Backus and J. Howard Johnston, who had previously made money by brewing in Lima. With them was associated Capt. Henry Guyer. In 1896 the business was incorporated under the laws of New Jersey as the Backus & Johnston Co. The lead ores gradually became scarce and copper ores were bought instead. The silver was extracted by the Ziervogel process and subsequently black copper produced. In 1899 this method was abandoned and the matte shipped abroad, a policy which is still followed. Mines were bought and purchasing contracts made for custom ore.

The smelter is situated on the Central Railroad of Peru 95 miles from Callao, the seaport. The elevation is 13,600 ft. above the sea and the inward trip occupies 8 hours. The chief mine is the Natividad, at Morococha, 20 miles north on a branch line of railway. The company owns part of this property and purchases the output of the remainder, known as the Carmen. The ore from these mines contains much lead and zinc as well as copper, necessitating modifications of the smelting plant. The present blast-furnace was blown in during August 1910 and pot-sintering was started in March of this year. I propose to give some account of the mine and follow the ore to the mill and smelter, describing the furnace and new pot-roasting plant.

At the Natividad mines the ore is found in three principal veins varying from a few inches to 8 ft. and averaging 2 ft. wide; these cut across the stratification of limestone, metamorphosed rocks (marl and slate), conglomerate, and the eruptive (andesite ?). The valuable metals are silver and copper, with which are associated zinc and lead. The minerals predominate in the following order: Zinc-blende, galena, pyrite, chalcopyrite, tetrahedrite, and occasionally pyrargyrite, in a quartz gangue; the tetrahedrite is argentiferous. The wall-rocks are usually firm; timbering being necessary only where stopes are wide and for manways and chutes. Overhand stoping has been used but the present plan is to change to the underhand system. All the hauling is done through the Carlos Francisco adit, which cuts the vein of that name, 5248 ft. from its mouth; it is straight the entire distance. No hoisting is done. The above mentioned vein is probably one of the premier lodes of the world in that it has been exploited for over 13,120 ft. on the strike, while on the surface it has been traced 16,400 ft.; in depth it has been cut nearly 2300 ft. vertically below its



Central Peru.

outcrop or 2550 ft. on the dip. The Backus & Johnston Co. does not own all of the vein, although controlling most of the output. A spur from the adit, where it cuts the vein, extends 2950 ft. southeasterly intersecting the Carmen vein 1640 ft. below its outcrop. Ore from these two veins is trammed by gravity, in trains of 4 1-ton cars, the rear car being fitted with a brake. The empties are hauled back with mules. Electric lighting is used in the adit. A 10-kilo. rail is used with 50 cm. gauge; the average grade is $\frac{3}{4}$%. During the driving of the adit, 459 ft. was done in one

month, on contract, using two 3¼ in. drills on three shifts, the face being 3 metres high, of the same width, and all the broken rock being trammed to the dump, at a cost of £6 per metre. No timbering was necessary; the rock was of medium hardness. Six drillers and their helpers were employed and about 24 shovellers and trammers. The ore, as sorted in the stopes, is run to a sorting-shed and hand-jigged. Coarse and fine concentrates are produced; the former is crushed and mixed before going to Brown roasters (or, as now planned, to the sintering-pots) and the latter to the bedding-floor prior to roasting. The mineralized rock not picked clean in sorting is sent in separate cars to the mill; the waste-rock is used for filling old stopes. About 125 tons of sorted ore and milling ore are trammed out per day.

The output for the mill is dumped over a 1½ in. grizzly, the coarse passing through a Blake crusher, the reduced ore and the fine going then to the stamps, of which there are 10 with a weight of 750 lb., a drop of 7 inches, 90 times per minute. A ½ inch screen is used, through which the crushed material from each battery passes to a 5-mesh trommel; the coarse material (about 15%) being discarded while the fine passes to spitzkasten, the coarse discharge of which goes to 2 Wilfley and 2 Overstrom tables. These are manipulated so as not to discard all the silicious gangue, the object of the concentration being to increase the silver, copper, and iron contents. A recovery of 66% of the metal contents is effected. The ore averages 15 oz. silver and 0·8% copper, the tailing 5 oz. silver and 0·5% copper, and the concentrate 46 oz. silver and 2·6% copper. An approximate analysis of the concentrate shows: SiO_2 7·5%; Fe 24%; Al_2O_3 0·6%; Zn 11%; Pb 14%; S 32%; Cu 2·5%; Ag 52 oz. The ratio of concentration is about five to one. At present about 70 tons is crushed per day, yielding nearly 14 tons of concentrate. (A new mill is being erected with a capacity of 250 tons daily; a No. 7 wet-grinding Krupp ball-mill is already in place, the capacity of which is 10 to 12 tons per hour through a 4 mm. aperture. The crushed material will pass to a 4 mm. Bunker Hill screen. The subsequent method of treatment will be determined by experiment). The concentrate is hauled to the bedding-floor where it is mixed with the hand-jigged concentrate and the crushed ore. The coarse hand-jigged ore and the custom ores are coarsely crushed and weighed out in the proportion to make a good mixture for the blast-furnace; then crushed in a dry-grinding Krupp ball-mill to 4 mm. size and wheeled to the bedding-floor. There the crushed ore and concentrate are mixed in proper proportion, and from the beds so made, charges are wheeled to the Brown roasters. The sintering plant will replace all this process, including the Brown roasters and briquetting machines.

Nearly half of the present tonnage treated is custom ore and that principally from the Carmen mine, which is higher in silver and silica. The ore coming from the Carmen vein proved an excellent flux where so much zinc had previously proved troublesome in smelting. Probably 1000 tons of Natividad ore is brought in each month; this is usually smelted raw, only the fine being roasted. From 5200 to 5500 tons of crude ore is treated per month. Of the ores purchased practically all are crushed fine and bedded, as already outlined. No custom ore is milled.

The mines and smelter are under the supervision of the general manager, John Galliver. J. Howard Johnston, one of the founders of the company, authorized the improvements. The 12-hour shift is in use, and the working day begins at 6 a.m. There are about 10 white men on the technical staff; and 1700 Indians (*cholos*) are employed. About 250 tons of ore, limestone, and coke are delivered daily, either by railroad, in mine-cars, or on llamas. Each class of custom ore is run to its respective bin and later weighed again, in one-ton charges, as already explained. Manual labour is used entirely, and although cheap it is costly where so much handling is done; the sintering plant, when in full operation, will eliminate this.

The power plant is notable for the absence of steam engines. Sufficient water-power can be obtained under heads of 90, 238, and 500 ft. respectively. The use of coal, at a cost delivered of £4 per ton, would prove expensive. There are two 150-kw. 3-phase alternating-current generators, belt-connected with two 250 hp., 4 ft. diam., 5-nozzle Pelton wheels; a small 3 ft. diam. 1-nozzle Pelton wheel, on the same shaft as the larger machines, is used as a helper when water is scarce. The smaller wheel operates under 500 ft. head, and the larger under 90 ft. head. A 5½ kw. exciter completes the dynamo-room equipment, exclusive of the switch-board arrangements. A transformer—from 450 to 110 volts—is used for lighting purposes. A 30 hp. 5 ft. single-nozzle Pelton wheel, operating under 70 ft. head, is used to drive two 6A Green blowers, and a 3 ft. single-nozzle Pelton wheel, under 500 ft.

head, is belt-connected to a No. 6 Root blower. The air from these blowers unites just before entering the bustle-pipe. About 10,000 to 12,000 cubic feet of effective air is supplied per minute. Near the Carlos Francisco adit a 3-drill Imperial air-compressor is belt-connected to a 40 hp. induction motor ; air at 65 lb. pressure is supplied to two $3\frac{1}{4}$ in. drills. The machine, blacksmith, and carpenter shops are sufficiently equipped for ordinary repair work. A new ditch, to supply a minimum of 500 hp. under 238 ft. head, is being constructed.

ditions have been made without apparent regard to proper arrangements for handling material, etc. ; the narrowness of the canyon, in which the buildings are placed, compelling extension longitudinally.

The roasting plant consists of two single-hearth Brown furnaces 180 ft. and 240 ft. long respectively by 10 ft. wide, arranged so that the discharge-ends face each other. Petroleum is used as fuel under an air-pressure of 12 oz. The material fed to the roasters is 4 mm. size or finer and has been mixed so as

THE CASAPALCA SMELTER.

No mechanical sampling is done ; hand-quartered samples of ores and fluxes are taken. As the contents of the several ores do not vary much, it has been found unnecessary to adopt a rigid system of sampling. The laboratory crushing plant is equipped with a 20 hp. induction-motor driving several small mechanical crushers. For the mattes a No. 1 dry-grinding Krupp ball-mill is used.

The present smelter occupies a terraced site ; the buildings are of corrugated iron supported on wooden framework. While the plant does not represent good practice, as regards design, it must be borne in mind that since it was erected (1888) improvements and ad-

to furnish a product suitable for the blast-furnace. The larger furnace has 8 cars on the carrier chain, each fitted with 9 plows ; the smaller furnace has 6 cars and the same number of plows ; the chain moves at the rate of 55 ft. per minute. When a crust accumulates a rake is fitted to one of the cars to break it down ; as a matter of precaution the rake is usually attached daily. The blower, a Root No. 5. is driven either with a 10 hp. motor or connected with a Pelton wheel, either serving also to drive the carrier chain for the smaller furnace. A 30 hp. motor drives the chain of the larger furnace, although 10 hp. is sufficient for

ordinary running ; the excess is required when the ore becomes sticky through cooling. The smaller furnace can produce 54·5 tons of roasted material per 24 hours, consuming 3·2 tons of petroleum ; the output from the larger furnace is 68 tons consuming 3·3 tons of petroleum. The high price of coal, the better roasting with less labour, and more mobility in operations, made the use of petroleum desirable. The oil comes from Lobitos in Northern Peru and costs £3·4 delivered at the smelter ; about 220 tons is consumed per month. There are two flues to each furnace ; previously one flue was used, but the additional one has resulted in better desulphurization due to the increased draft. About 70% of the sulphur in the charge is driven off ; there appears to be a slight loss of zinc and lead, but little flue-dust is made. The following approximate analyses indicate the nature of the material charged and the roasted product :

	Charge. %		Roasted product. %
SiO_2	25·0	...	27·0
Fe	15·6	...	18·0
CaO	1·5	...	3·5
Zn	10·0	...	9·2
Pb	11·0	...	10·3
Al_2O_3	4·4	...	2·1
S	24·0	...	7·6
Cu	5·0	...	6·4
Silver	45 oz. per ton	...	50 oz. per ton.

Reduction in weight due to roasting amounts to 10%. The product requires briquetting to make it suitable for the blast-furnace. The adoption of the sintering process has tended toward lower cost, better desulphurization, a more desirable product for the blast-furnace, and less flue-dust. The roasted ore is wheeled to a cooling-floor to be fed later, with flue-dust and calcined limestone, to a long-trough helical-screw mixer and then elevated to a bin behind a briquetting machine of the White-Boyd-Chisholm type. Six bricks (each 3 by $4\frac{1}{4}$ by $8\frac{1}{2}$ in.) are made per stroke ; the average weight per brick is $8\frac{3}{4}$ lb. The average daily capacity is about 30,000 bricks. Each day's output is stacked separately ; samples are taken by knocking off a fragment from some of the bricks as they are being stacked. From the stack-pile the bricks are put into barrows and wheeled to the blast-furnace. Considerable labour, although cheap, is necessary for moving the product.

The sintering process has proved a success not only from the metallurgical point of view by furnishing a product already semi-smelted, from which little or no flue-dust results, but also by effecting a reduction of expenses, thus turning a doubtful proposition into a profitable one. After experimenting on a small scale, the present type of pot was decided upon.

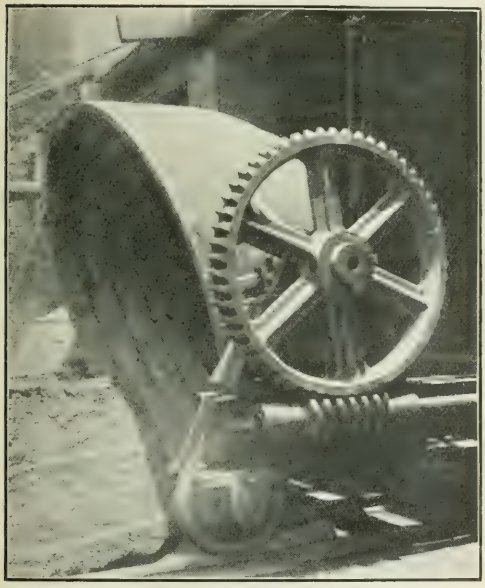
An approximate analysis of the ore is as follows :

	%
SiO_2	25
Fe	15·6
Al_2O_3	3·8
CaO	9
Zn	11
S	24·4
Pb	6
Cu	3·5
Ag	44 oz. per ton

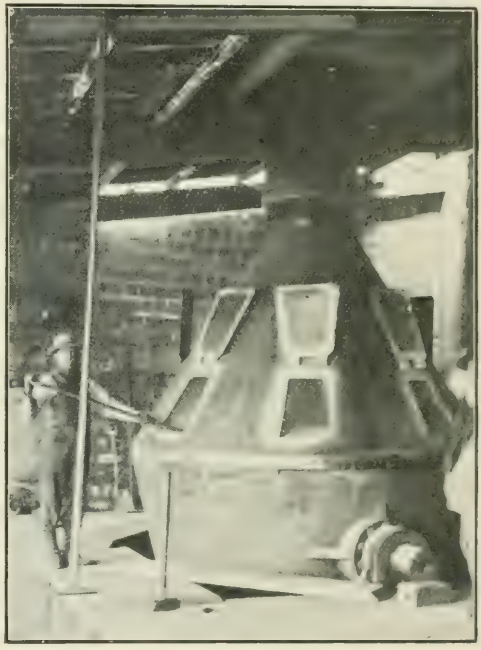
The ore is crushed to pass through $\frac{3}{4}$ in. mesh, and is then mixed, by hand, with silicious material and lime if necessary. This charge, containing about 5% moisture, is delivered to bins above the pots. It was found by experiment that a 5% moisture content gave the best results ; a 12% content made it impossible to operate.

The type of pot, hood, and carriage are shown in the accompanying photographs. The pot is 8 ft. 8 in. diam. at the mouth, with the shell 2 in. thick, which tapers to $1\frac{1}{8}$ in. at the bottom ; this casting weighs 11,000 lb. The height inside, from grate to rim, is 3 ft. 6 in. From the top of the shell to the centre of the trunnion, which has been determined as 2 in. below the centre of gravity of the loaded pots, is 24 in. The inside surface of the shell has four shoulders, or offsets, of $\frac{7}{8}$ in. each, regularly spaced, the object of which is to prevent the creep of the air-blast. The grate, $1\frac{1}{8}$ in. thick, is slightly arched, on an 11 ft. radius, with the idea of better resisting the load ; it is divided into three pieces, the centre one being the largest, with side pieces of equal size. It stands 14 in. above the bottom of the shell, or inlet of the blast, resting on a shoulder 1 in. wide and bolted to the outside of the pot. The air-holes are 1 in. diam. at the inlet, and $\frac{3}{8}$ in. at the outlet, spaced $2\frac{1}{4}$ in. between centres and a like distance, vertically, between the middle of these centres. The blast-pipe is 6 in. diam. and so arranged, with a sleeve connection, that it can be disconnected when the pot is to be raised. The hood, covering the pot, has an inside rim that fits into the inside of the shell. It has eight openings, seven of which can be closed according to required conditions. The eighth opening is to allow the chute from the bin to enter, and it cannot be closed. The hood is raised or lowered into position by a hand-wheel arranged above the outlet stack of

the hood, connected with a rod passing through the centre of the frame. From this stack, which is 30 in. diam., the connection leads off to the discharge chimney. At present there is no flue-dust chamber, but it is probable that when the proposed 20 pots are in operation one will be erected. The pot is operated through a worm gear. The track on which the pot runs has a slight downward grade to assist in moving the pot forward when ready to dump. The carriage is held in position, during the sintering and desulphurization, by a $\frac{3}{8}$ in. wire rope, controlled by a hand-winch. The capacity of the pot is 9 tons of crude ore; the runs made thus far indicate that 11 tons



A Pot after Discharge.



Pot in Operation. Baking a charge

can be charged. The pot and carriage, complete, have been made in Lima at a cost of £300, which seems a high price. Including freight and erection of hood and shed, and the pot ready to run, the total cost was £500.

The pot is charged, at 6.45 a.m., with shavings and wood to a depth of 3 to 4 inches. This is set on fire by an oil-dipped rag, which is dragged over the surface. Once fairly ignited a light blast—about $\frac{1}{2}$ oz.—is turned on, and after a few minutes 100 lb. of fine coke (less than $\frac{3}{4}$ in. size, which was previously thrown away) is spread over the fire. After the coke has ignited a charge of 100 lb. of limestone is thrown in and spread out. The limestone prevents the bottom of the charge from becoming too hot and possibly melting. Sufficient time is then allowed until it appears red before the first charge—300 lb.—is thrown in and the blast slightly increased. Soon after the ore has been spread over, using an ordinary garden rake, the heavy yellowish sulphur fumes begin to come off and the ore crackles. When the mass has begun to turn slightly red, 300 lb. of charge is shovelled in and spread. After the fourth charge has been added, making a total of 1200 lb., and the pressure slightly increased, shovelling is discontinued, all the charging being then done through the chute from the ore-bins. Charges of 800 lb. are then made, with increases as the wider diameter of the pot is reached. The mass tends to pack in the pot so that punching, from time to time, is necessary to allow the gases to escape and to permit the air to penetrate. It is noted that immediately after a charge has been made, the pressure rises one to two ounces, then returning to the normal amount as soon as ignition occurs. As the charging proceeds, the volatilization of the sulphur takes place more quickly after spreading, and toward the end, when the pot is nearly full, the sulphur fumes come off almost instantly. With the increase of the contents of the pot, the blast-pressure increases, so that by the time the full charge

has been made (about 5.30 or 6 p.m.) there is $5\frac{1}{2}$ oz. pressure. The surface is comfortably warm and where holes have been punched, the interior of the mass shows red-hot and the sintering action can be seen; there is no blowing away of the light particles of mineral. Bright bluish and red flames are emitted, succeeding the heavy yellow fumes of sulphur and the bluish white sulphurous gases; the surface of the mass resembles a blacksmith's forge-fire. There is a slight smell of sulphur gases, usually only when charging this being due to the good services of the hood. The shell is warm, cooler at the bottom than the top. The heaviest part of the operation has now been completed and no further attention is paid to the pots except the increase of pressure, every few hours, which reaches a maximum of 9 to 10 oz. by 5.30 a.m., at which time the blast is cut off. At present an old type of rotary blower is used, connected by belt with a rated 15 hp. motor. No fumes are apparently given off, at this period, while the surface of the mass is well crusted, and the interior is red hot, but agglomeration is not evident. The day-shift of 12 hours comes on at 6 a.m. and prepares to dump the pot. The winch-rope is eased, the blast-connection is lowered out of place, the hood raised to clear the edge of the shell, and the carriage barred to get it into motion. When the pot is ready to be dumped, having been moved out from the hood, the worm gear is set in motion until the pot stands at an angle of about 97°, the entire sintered mass slides out on a mat of old rails, piled on the ground, thus slightly breaking the fall and shattering the mass. There is no barring or other means necessary to induce the quick discharge of the sintered product. Hardly any odour of sulphur gases, and no fume, is given off except when water is sprayed to hasten the cooling; some SO_2 gas is generated, but not sufficient to be annoying. The pot is scraped, on the sides and grate-plate, and then revolved back to its normal position and hauled to its place, under the hood, by means of the winch. Usually 15 to 20 minutes are required to discharge both pots, from the beginning of the disconnection until the pots are ready to be fired once more. Three men and a foreman can easily attend to the work. The sintered mass is cooler at the bottom than the top, as is to be expected, the former place being the seat of more recent desulphurization and sintering. Sledging is necessary to break up the mass, using bars to ease the work. The two sintered masses can be broken up by 4 men in 8 hours; the amount of fine resulting is small and lumps suitable for the blast-furnace can be made. The texture of the sinter is porous but the mass holds well and is tough.

There is apparently but little flue-dust made. A slight amount of lead and zinc may be volatilized. The desulphurization amounts to 75%. The charge suffers a reduction of about 10% in weight.

The sinter shows the following analysis :—

	%
SiO_2	28·6
Fe	15·8
Al_2O_3	3·9
CaO	10·6
Zn	10·8
Cu	4·1
S	6·1
Pb	5·4
Ag	48 oz. per ton.

The product is quite self-fluxing and well suited for the blast-furnace.

The advantages of the sintering process over the Brown roasters and briquetting seem to be as follows :

1. Less labour required (possibly 50%);
2. Greater desulphurization; at least 5% more;
3. Better smelting product. It is stated that a large proportion of the work of the blast-furnace is accomplished in the pots and that the blast-furnace can smelt 40 to 50% faster;
4. Less repairs;
5. Less interference with continuous operations;
6. Less room for plant of greater capacity;
7. Decreased flue-dust in the blast-furnace;
8. Less coke consumed in the blast-furnace;
9. Saving in flux;
10. Less capital invested in the plant.

The present blast-furnace was blown-in on August 6, 1910. It is a standard type of American water-jacketed furnace, all the ironwork having been made in Lima. The inside length, at the tuyeres, is 160 in. and the width 42 in.; the tuyeres, 12 on each side, are 6 in. diam. and spaced 12 in. apart; there are no end-tuyeres. From the centre of the tuyeres to the charging-floor the height is 10 ft.; the height of the charge is usually 7 to 8 ft., that is to the top of the water-jackets, of which there are 10, three to each side and two to each end, with a $3\frac{1}{2}$ in. water-space. There is a 6-in. bosh to the upper $6\frac{1}{2}$ ft. of the side jackets; there is no end-bosh. The slag-spout is jacketed. The water for the jackets circulates automatically, the cold water entering the

bottom of the jacket, from a tank above the feed-floor, and the warm water flowing off from the top. There is no brickwork inside the furnace except in the crucible; the feed-plate castings overlap the jackets. The crucible is supported on a solid foundation; the upper part, which is in contact with the matte, is of fire-brick, resting on a concrete foundation, and all held together by iron plates and tie-rods. All the fire-brick employed is of foreign make. The depth of the crucible is 12 in.; the slag tap-holes—one on each end of the furnace—are 16 in. below the tuyeres, and the matte tap-holes—one to each side—are 12 in. below the slag tap-holes. The slag

SMELTER FUME. THE CASAPALCA SMELTER IN PERU.

flows away continuously into a settling-pot, the overflow from which drops into a hole in the floor, to be granulated and swept away by water to the river. The slag is sampled every half-hour, while samples of matte are taken every four hours. A two-foot bustle-pipe supplies the air, about 260 cu. ft. of 'effective air' (or 430 cu. ft. of 'free air') per square foot of hearth-area at the tuyere-level. The air-pressure varies from 11 to 15 oz. The top of the furnace is closed, the fume passing off through a straight brick flue and then to a dust-chamber, thence to another flue connecting with two chimneys. About 7% flue-dust is made. The total length of the dust-chamber is about 200 feet.

A hydraulically operated elevator, using water under 70 ft. head, lifts 40 ft. It is used to handle matte, slag, flue-dust, and concentrate from the tapping-floor to the feed-floor (15·5 ft.) or roaster bedding-floor (40 ft.) All charging to the furnace is done by hand, the raw ore, briquettes, sinter, fluxes, lime, and coke being wheeled to the charge-doors, after having been weighed. Coke is charged first, then ore, sinter, matte, lime, slag, and briquettes, through the charge-doors, of which there are four to a side; the centre ones are opened together and then these dropped back into place and the end ones opened. It takes from 8 to 10 minutes of shovelling to a charge, which is from 4500 to 6200 lb. including the coke. From 45 to 60 charges are made per shift, the higher figure obtaining when the furnace is running well. A door on each end of the furnace is used when removing crusts. Coke to the extent of 9 to 11% of the charge is fed. It contains from 5 to 10% ash and is of Westphalian make, costing delivered at the plant £4 per ton. The size used for the blast-furnace is $2\frac{1}{2}$ in. and larger; between $\frac{3}{4}$ in. and $2\frac{1}{2}$ in. is sent to the lime-kilns and forges, and less than $\frac{3}{4}$ in. is used in the sintering pots. The SO_2 gas present is not overwhelming. About 80% of the sulphur in the charge is volatilized. About 10% sulphur is carried as an average of the ores, sinter, briquettes, and matte. There is usually no hot top although overfire is, of necessity, present. An approxi-

mate idea of the charges run can be obtained from the following figures:

February 14, 1911.	6 a.m. lb.	10 a.m. lb.
Raw ore	500	500
Slag	400	400
Lime	600	300
Sinter	500	500
Matte	400	400
Briquettes	3000	2000
	5400	4100
Coke	600	400
	6000	4500

The matte from the 6 a.m. charge ran too low in silver and copper. The slag fed is added to make smelting easier. The matte fed is low in silver (contracts calling for over 400 oz. per ton); it tends to make the furnace run faster.

The following approximate analyses are of interest:

	Raw Ore Natividad	Raw Ore Carmen	Sinter	Roasted Ore	Slag	Matte
	%	%	%	%	%	%
SiO_2	17·2	47·0	28·6	27·0	40·8	—
Fe	24·0	4·9	15·8	18·0	20·9	14
Al_2O_3	1·4	2·4	3·9	2·1	5·5	—
CaO	trace	6·4	10·6	3·5	15·8	—
Zn	3·4	9·6	10·8	9·2	10·3	6
Pb	—	7·2	5·4	10·3	—	6
S	31·4	8·5	6·1	7·6	—	22
Cu	13·7	1·6	4·1	6·4	0·3	50
Mn	—	1·5	—	—	—	—
	oz.	oz.	oz.	oz.	oz.	oz.
Silver	11·3	52	48	50	1·1	400

The blast-furnace flue-dust is stated to be similar in composition to the roasted ore. The concentration is 10 : 1. The matte when tapped runs into a Kilker matte-casting car; after cooling it is dumped in front of a crusher, in which the larger lumps are reduced; 268 bags of matte constitute a lot of 20 tons, the capacity of a freight-car. From 12 to 20 tons of matte are produced daily according to the running of the furnace. Samples are taken as each bag is weighed. At present the product is shipped to Liverpool. It is expected that a minimum of 3,000,000 oz. silver and 7,000,000lb. copper will be produced annually, when the improvements now contemplated shall have been made. The matte contains only traces of gold.

The following statistics will prove interesting:

	Silver Oz.	Copper Long tons
1899	1,034,981	1,187
1900	1,151,504	1,742
1901	836,235	1,573
1902	788,370	1,650
1903	871,882	901
1904	936,949	861
1905	1,020,108	1,816
1906	883,745	1,629
1907 } 1908 }	1,804,023	2,902
1909	1,094,859	1,125
1910	1,877,321	2,235
Total	12,299,977	17,627

At present about 700 men and boys (earning from 0·60 to 1·20 centavos, that is, 1·2 to 2·6 shillings, per day) are employed in the smelter. Living is naturally trying at such a high altitude, and is often made more so owing to the settling of the sulphurous gases in the canyon. The rainy season is disagreeable, but in clear weather the climate is quite invigorating; the nights are cold. Quarters for the white staff have been made comfortable. The present hospital is cramped for room, but this will shortly be remedied.

The management declines to give data as to cost during the present period of re-construction, although most generous in supplying the data for this article.

Rankin's Process. — The extraction of metals from low-grade sulphide ores is a problem that has attracted Colorado chemists and metallurgists during the last few years. We recently referred to the attempt to introduce the chlorine reaction. We are now informed that the nitric acid treatment is being tried with a 50-ton plant at Lake City, operated according to the patents of H. D. Rankin. The action of nitric acid on metallic sulphides is to produce sulphates. Owing to the cost of the acid and the difficulty of recovering it, no practical application has ever been possible. Mr. Rankin has devised a plant which it is claimed will sulphatize any ore and recover the nitrous fumes evolved by the reaction. He states that he can regenerate the nitric oxide fumes (NO) to nitric peroxide (NO_2) and subsequently by means of compressed air in an absorption tower obtain nitric acid once more. The disadvantage is that with plain sulphides other processes work better, and that if the ore is complex or low-grade it will be impossible to recover much of the acid.

PRÉCIS OF TECHNOLOGY

The Giesecke Ball-Mill.—The *South African Mining Journal* for May 20 gives a short account of the Giesecke ball-mill, which is made in Brunswick, Germany, and is being tried at the Geldenhuis Estate on the Rand by H. Stadler under the advice of the inventor. The mill appears to act on the same principle as that invented by Hardinge, but instead of being made conical it consists of two cylinders bolted end to end with no intervening screen but separated by a dividing annular rib having a comparatively small central aperture. Or it may be considered as a combination of a ball-mill for coarse grinding and a tube-mill for fine-grinding, joined together end to end, with a small circular opening between them. The length is 23 ft.; the length and diameter of the first section are each 8 ft., and the other part is 15 ft. long and 6 ft. diam. The latter part is divided into two compartments by means of a similar annular rib. In the three compartments thus made steel balls are used for crushing and grinding, and their size is graded according to the size of the ore to be crushed. In the first compartment with large diameter the balls are 4 in. diam. and in the third they are 1½ in. diam. In the interior of the cylindrical surface, fall-plates of steel are placed. These lift the balls and ore as the mill revolves and provide an efficient fall for them. The proportion of water to ore is 1 : 3. The eventual discharge is regulated by a 60-mesh screen. The mill is intended to displace stamps entirely and to produce a fine product of sand and slime in one operation. Amalgamation will not be used, but the product cyanided direct.

Tin in Rhodesia.—In the *Rhodesian Mining Review* for May 24, H. B. Maufe, Director of the Rhodesian Geological Survey, gives the result of a personal examination of the tin deposits recently found in the Enterprise gold-belt of Rhodesia, situated 30 miles east of Salisbury. The cassiterite is found in greisenized pegmatite dikes which are intruded through the metamorphic rocks of the district. These rocks may be divided into three groups: (1) epidiorite with intercalated bands of schist; (2) 'ironstone' including limestone; and (3) quartzites and conglomerates. They have been intensely compressed by forces acting in a north and south direction and so folded along east and west lines. The general dip of the rocks is northerly. The tin-bearing dikes pass through the rocks in (1) and (2) and their general trend is north and south. The metamorphic rocks are surrounded on the north, east, and south, by granite which has been intruded into them. There are also small intrusive bosses of granite, and bosses and dikes of dolerite and norite. The granite is a medium-grained biotite variety, and sometimes contains hornblende. Normal pegmatite dikes are abundant near the edge of the encircling granite, and they extend some distance into the metamorphic rocks. They consist of an intimate growth of white felspar and grey quartz in varying degrees of coarseness. White and black mica are occasionally present, and red crystals of garnet are in some places found in narrow bands or small bunches. These normal pegmatite dikes have not so far been found to contain cassiterite, and theoretically are not likely to do so. The greisenized pegmatite dikes are not in the neighbourhood of the encircling granite, but some are not far distant from the small intrusive bosses. The most characteristic feature is a pink mica which was supposed by the prospectors to be fluorspar. An examination showed that it is lepidolite or lithium mica, which is often associated with pegmatite in other parts of the world. The dikes consist essentially of quartz, lepidolite, and felspar, with small amounts of fluorspar, garnet, topaz, and cassiterite. The relative proportion of these constituents varies greatly, and the degree of coarseness also varies a good deal. In the unaltered parts the grey quartz and white felspar are intimately intergrown. In partly altered parts the original large crystals of felspar are separated into rounded lumps each encircled with a zone of lepidolite and secondary quartz. Other parts have been completely altered to greisen and the original felspar is absent. Here the aggregate of quartz and lepidolite is in places coarse in grain, and in other places so fine that the individual crystals are only just distinguishable to the unaided eye. These fine-grained portions occasionally exhibit a banded structure owing to the greater abundance of the mica. These bands are in wavy lines, suggesting successive incursions of the vapour which caused the alteration to greisen and introduced the tin. The cassiterite seldom shows crystalline structure, but is found in the form of irregular black grains which have an uneven fracture. The lustre is inclined to be resinous rather than adamantine. In the coarsely crystalline portions of the dikes, the cassiterite occurs in grains up to one inch in length and is generally associated with the quartz; but in the fine-grained parts, it is more evenly disseminated in very small grains. Mr. Maufe proceeds to give descriptions of a number of veins that have been prospected. While not enthusiastic as to their extent and regularity as at present determined, he considers that exploration at depth is fully warranted. He emphasizes the different nature of the deposits from those found in the northern Transvaal. It is also notable that no tourmaline is found in the greisenized pegmatite, though it occurs in narrow veins which traverse the schists surrounding one of the small norite bosses.

Price of Glycerine.—Several notices have appeared in the technical Press recently announcing that the price of dynamite and allied explosives will advance in the near future in a way that will be highly inconvenient to those engaged in mining operations, owing to the increased price of glycerine which is the base of nitro-glycerine manufacture. *The Times* of June 13 contains a timely article on the commercial position of glycerine and explains the reasons for the enhanced price. Glycerine is a by-product in soap manufacture; when animal and vegetable oils are treated with alkali, soap and glycerine are formed. Except for its use in pharmaceutical preparations, glycerine was of small commercial value until nitro-glycerine was invented, and nowadays owing to the restricted circle of explosive makers little is heard of it as an ordinary market commodity. The 'spent lye' left behind in the manufacture of the best soaps contains about 9% of glycerine. The relative amount of glycerine and soap produced by the reaction varies widely according to the nature of the raw material and the kind of soap produced. Most of the soap makers boil the lye down to produce a crude glycerine containing 80%, though some of the producers of poor quality soap throw it away. Only a few of the large houses make a refined product; the others either sell the crude to the bigger firms, to the limited number of explosive manufacturers who undertake refining, Nobels being the chief, or to merchants who buy for America. The British Government cordite works do not refine, but buy mostly from Nobels. At the beginning of 1907, crude glycerine was worth £28. 10s. per ton, and refined £50 per ton. By the end of the year crude had advanced

to £68 and refined to £105 per ton. The cause is due chiefly to the advance in the price of oils and fats. The soap maker has found it impossible, or at least injudicious, to recoup himself by increasing the price of soap, owing to its being a national commodity necessary to the poorest classes, so he has had to turn his attention to the other outlet of his products. It is interesting to note that the chief reason for the advance in the price of fats and oils is their increasing use in the manufacture of margarine. Some of the largest soap makers have found it necessary to protect themselves by becoming their own producers of vegetable oils. Taking all these facts into consideration it is obvious that the price of explosives will, unfortunately for the mines, continue to advance.

Temperatures at St. John del Rey.—As has already been recorded in our June number, and in the Company Reports on another page of the present issue, the Morro Velho gold mine in Brazil that has been worked continuously for 80 years by the St. John del Rey Mining Co. is the deepest in the world. Level No. 17 which is now being developed is 4600 ft. vertically below the adit or 4920 ft. below the surface. The lode dips at approximately 45° and as shown in the illustration given last month operations below Level 8 are conducted by means of underground vertical shafts, named 'E' and 'F,' each 1200 ft. deep, and extending from Levels 8 to 12 and 12 to 16 respectively. Level 16 at 4300 ft. below adit has now been driven nearly far enough for the commencement of another shaft, 'G.' The levels are 300 ft. apart. As the lode shows every sign of persistence, George Chalmers, the manager, is making arrangements for work to be continued to a depth of 6500 ft. Efficient ventilation for the purpose of reducing the temperature of the air and rock is, of course, of prime importance. Mr. Chalmers gives much interesting detail in connection with his investigations on this subject in his report on the progress of the mine during the year ended February last. Before the 'F' shaft was completed the workings on the 14th and 15th levels were unpleasantly hot, but directly through connection was made the conditions rapidly improved. At the present time the ventilation is effected by a Capell fan driven by a 80 hp. motor, at the surface, together with some auxiliary fans underground. It has now been decided to provide two more fans, only one of which will be put in commission at first, and driven by a 150 hp. motor. As the depth of the workings increases the second will be started with a 300 hp. motor, and later the first fan will be driven by a 300 hp. motor. The accompanying chart gives a diagrammatic record of the results of investigations. During the four hottest months of the year, November to March, temperature readings were regularly taken of the air at each level and of the rock at the end of 10 ft. holes. The mean of the air temperatures is shown in the line P, and of the rock temperatures in the line Q. It will be seen that from adit to Level 8 the air temperature is slightly greater than that of the rock. Thereafter the rock temperature becomes greater. From Level 14 to 17 both advance more rapidly, a fact due to these levels having been open only a comparatively short time, and the rock having been exposed to the cooling effect of only a small quantity of air. The figures relating to the original temperatures when the rock was first exposed at various points and the subsequent fall in the temperatures are of considerable value in helping to forecast future conditions. On Level 14 in 1906, when it had just been reached, the rock temperature was 98°F as marked at A, and the air temperature 95°F marked at B. As soon as the level was connected with the ventilating system the rock temperature fell to 92½°F marked at C, and that of the air to 87½°F marked at D. With the more efficient system of ventilation now introduced it may be assumed that the lines P and Q will not curve to the right, but will more or less follow their straight course from adit to Level 8. The probable increase in the air temperature may therefore be expected to follow the line R. This line cuts the abscissa representing a depth of 6500 ft. at a temperature of 95°F, which is practically the temperature of the workings at Level 16 at the time of writing, so it may be supposed that with efficient ventilation operations can be conducted at this depth. The rock temperatures at the time of opening are estimated on the chart by drawing a line S through the two points A and E which, as far as can be exactly ascertained by means of long bore-holes, represent the actual rock temperatures at Levels 14 and 17 before developments were begun. At 6500 ft. the temperature at which the rock is opened is in this way shown to be 117°F. If as already calculated the air temperature can be reduced by ventilation to 95°F, it would appear that work could be continued to an even greater depth than 6500 ft.

Goldfield Consolidated Mill.—A particularly valuable series of articles is now appearing in the *Mining and Scientific Press* describing in full detail the operation of the mill and extraction plant erected two years ago at the Goldfield Consolidated mine, Nevada. The first appeared in the issue of May 6. They have been written by J. W. Hutchinson, the director of metallurgical operations. The ore is an enriched dacite, and the workings are now in the sulphide zone where the ore becomes much softer. The gold is in a fine state of division and the whole of the ore is slimed to 200-mesh before any extraction is attempted. The pulp is then sent to Deister slime tables. The concentrate is passed over amalgamation plates and treated in Pachuca vats and Kelly presses, while the tailing is sent to the main cyanide plant which consists of Pachuca vats, Butters filters, and Merrill precipitation plant. The value of articles such as these depends on the wealth of detail, and naturally they do not lend themselves to the purposes of the précis writer. There is, however, one aspect of the crushing problem that may be referred to in this column. When the plant was erected, 100 stamps each weighing 1050 lb. were provided. These crushed to 12-mesh, and subsequent reduction to 200-mesh was effected in 10 tube-mills. Six months afterwards, when the old Combination mill was put out of commission, it was decided to increase the capacity of the new mill from 600 tons to 850 tons per day, and in order to do this 40 additional stamps and 3 tube-mills were to be added. Additional buildings, ore bins, etc., would of course be necessary, and the total cost of the extension was estimated at $175,000, while the time occupied in the construction and erection would be 6 months. Mr. Hutchinson, however, was not in favour of this scheme, and eventually a different plan was followed, namely, the placing of six 6 ft. Chilean mills between the stamps and tube-mills. The battery screens were altered to 4-mesh, and 16-mesh screens were put in the Chileans. In practice it is found that 80% passing through the Chilean screens is less than 30-mesh, and in fact 30% will pass 200-mesh. The cost of the new installation including 24 new slime-tables was only $75,000 and it was ready for work in less than 3 months. Mr. Hutchinson enters into details as to the amount crushed by the old and new systems, and the relative power required, and discusses the advantage obtained by the new arrange-

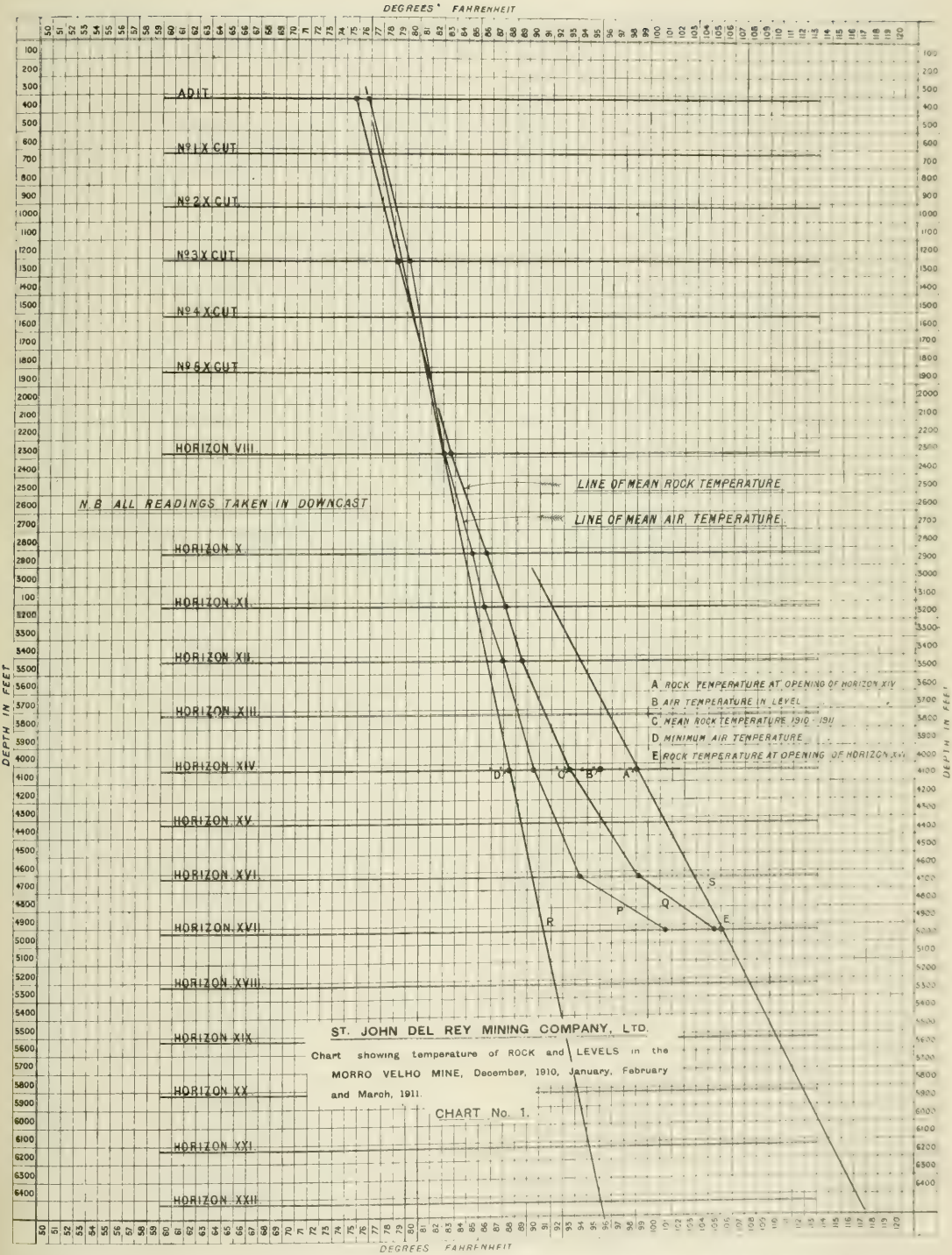


CHART OF TEMPERATURES AT THE MORRO VELHO MINE OF THE ST. JOHN DEL REY MINING CO.

ment which permits the ore when fine enough to be removed from further treatment. To those who have not hitherto followed the metallurgical treatment at this mine, the bulletin describing the plant issued by the Allis-Chalmers Co. will prove of explanatory value. We would also add that the articles have been republished in pamphlet form.

Chilean Mills versus Rolls.—In *Metallurgical and Chemical Engineering* for June, Rudolf Gahl describes experiments undertaken at the concentration plant of the Detroit Copper Company at Morenci, Arizona, with a view of ascertaining the relative efficiencies of Chilean mills and high-speed rolls when used for the purpose of re-grinding jig tailing. He does not discuss the question from the point of view of power consumed or of keeping the two machines in good working order, but confines himself to the study of the comparative amount of slime produced and the percentage of copper recovered. In view of the facts that the Utah Copper Co. has a large installation of Chilean mills for re-grinding jig tailing and is about to apply a form of stage-crushing to them, and also that at the Miami copper mine, Chilean mills are used in one unit and high-speed rolls in the other, Mr. Gahl's paper is of special interest. His tests were made with a 5 ft. Chilean mill run at 136 r.p.m. and with rolls 36 in. diam., 15 in. long, and running at 140 r.p.m. The oversize from the rolls was as is the usual practice returned to them. The first test was on material that passed through round holes 7 mm. diam. but not through 5 mm. holes. and the discharge screens of both plants had 2½ mm. holes. The analysis of the results is given as follows :

Mesh	Percentage	
	Rolls	Chilean Mills
+20	23·1	11·0
20 to 30	16·0	7·0
30 to 100	23·4	21·2
100 to 200	6·6	9·3
−200	30·9	51·5

It will be seen that the Chilean mill made a much finer product and a great deal more slime. In test No. 2 the material treated was between 5 and 2½ mm. with the same discharge screens as No. 1, and the general result was much the same. He then proceeded to ascertain whether the copper mineral was as efficiently freed from the gangue in the rolls as in the mills, by treating each size produced by the two machines, on Wilfley tables up to 200 mesh, and the slime by panning. It was found that more copper was lost in the Wilfley tailings from the roll product than from the Chilean mill product, and that though more slime was made in the mill, the total recovery was slightly greater in the mill than by the rolls. A third test was made with 5 to 2½ mm. material, with 1 mm. round hole screens on the Chilean mill and wire mesh screens with aperture 0·79 mm. in connection with the rolls. The result obtained was that the eventual recovery of copper was practically the same in both cases, the mill losing more in the slime and the rolls in the sand. If no further facts in connection with the general concentration problem are taken into consideration, the mill would be the best machine to use, because it is simpler and easier to keep in efficient working order. If however any subsequent regrinding of the coarse pulp from the mill or rolls is contemplated, the decision in favour of the mill is not necessarily final, because the coarse product of the rolls contains more copper that can be freed by further regrinding. The author subsequently made experiments with Chilean mills with a view to reducing the amount of slime produced, and endeavoured to reproduce the conditions obtaining with rolls, whereby the material when ground sufficiently fine is immediately removed. He fitted the mill with a 3 mm. slotted screen when treating 5 to 2½ mm. material, and passed the discharge to a wire screen with 0·79 mm. aperture, the oversize being returned to the mill. He does not give full details of the results in his paper, but his conclusion is that by this re-arrangement of the work of the Chilean mill the proportion of slime can be reduced to approximately the same as that produced by the rolls. By such an arrangement the advantages of the rolls from the point of view of slime production would be gained by the Chilean mill while retaining those already possessed by it. He wishes it to be clearly understood that his comparison of the two machines is limited to the sizes of material mentioned, for with coarser material the superiority of rolls is unquestioned.

Duralumin.—This metal has been prominently before the public recently because Vickers Sons & Maxim have used it in the construction of the latest airship built for the British War Office. It is made at Duren in Rhenish Prussia, and was described in *Elektrotechnische Zeitschrift* for April 27. It is composed chiefly of aluminium with an admixture of ½% magnesium, 3½ to 5½% copper, and 0·5 to 0·8% manganese. It is claimed that these additions greatly increase the strength, hardness, ductility, and resistance to chemical attack. The specific gravity varies between 2·75 and 2·84, and the melting point is 650°C. The electric conductivity is less than that of pure aluminium. If heated above 150°C, its strength rapidly diminishes, so it is of no value in power or chemical plants. It is undesirable to use it in contact with copper or brass, so rivets must be made of the same metal or of iron.

Efficiency of Suction Pumps.—Mining engineers sometimes forget that the altitude above the sea and the temperature of the water have an important bearing on the height to which water can be elevated by suction, and are puzzled at the poor results obtained at high elevations or when the sump water is made hot by exhaust steam from underground pumping or hauling plants. J. T. Beard contributes useful information on this subject in *Mines and Minerals* for June. The elementary principle is that water, mercury, or other liquid can be sustained in a tube with a closed top to such a height that the column is equal in weight to a similar column of the atmosphere. The pressure of the atmosphere at normal temperature at sea-level is approximately 14·7 lb. per sq. in. A cubic inch of mercury weighs 0·49 lb. and a cubic inch of water 0·03608 lb., so that the height of the respective columns will be 30 in. and 34 ft. As the altitude above sea-level increases, so does the height of the column that can be raised decrease; the figures for the various altitudes are given in standard reference books. The point which is usually neglected is the vapour tension above the column due to volatilization. At the normal temperature 62°F the amount of water volatilized and filling what would otherwise be the vacuum is comparatively small ; the vapour tension is 0·273 lb. per square inch, which reduces the column of water supported to 33·3 ft. If the water is heated the vapour tension greatly increases. At 150°F the tension is 3·7 lb., so that the height of the

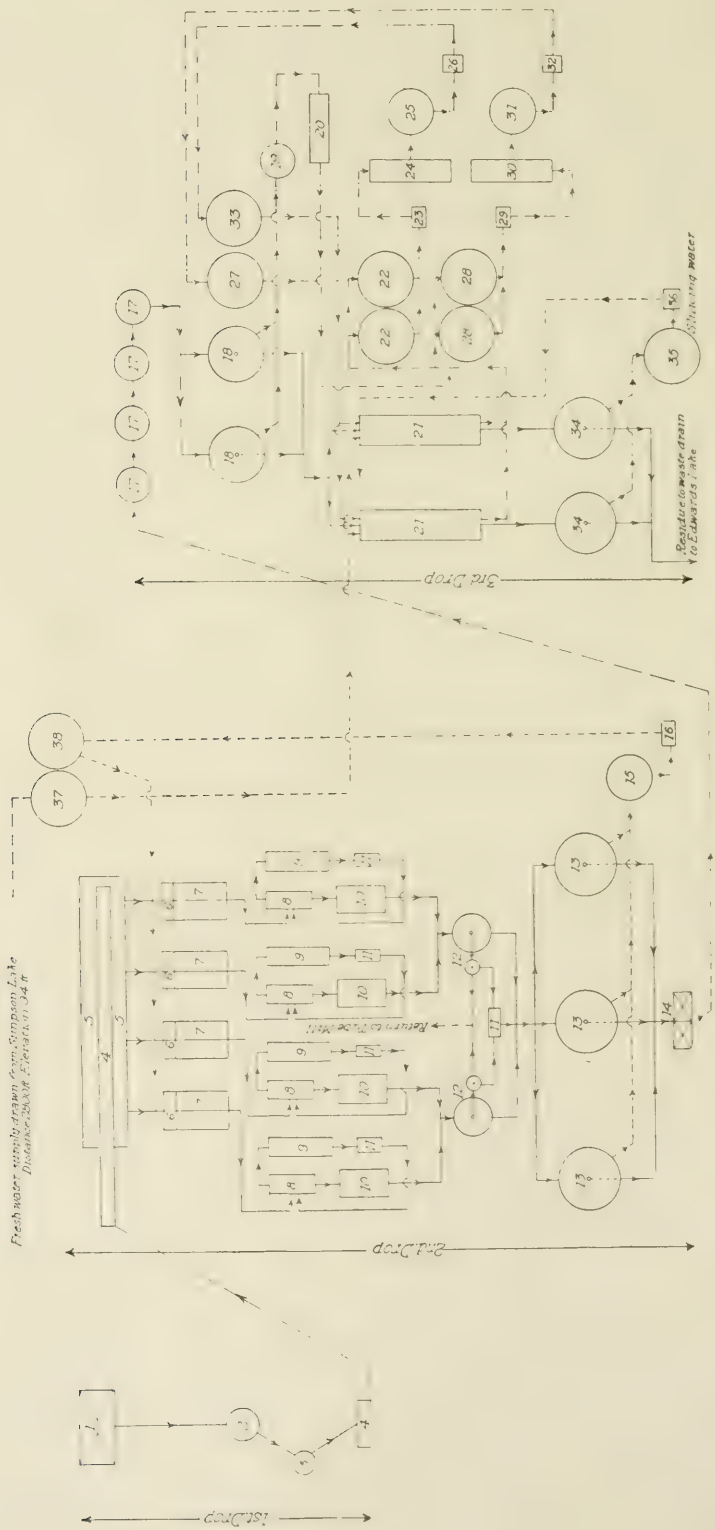
column of water raised is only 25 ft.; while at 180°F the tension is 7½ lb., and the column of water raised is only half what it would be at normal temperature. In actual practice there is a third factor to be considered, that is, items relating to the mechanical efficiency of the plant, such as leakage, friction, and the presence of air in the water; Mr. Beard considers that 25% must be deducted for these causes. Taking the three factors together he has worked out the accompanying useful table, which is so complete that it requires no further explanation. It will be seen that at an altitude of 10,000 ft., water at 180°F can be raised less than 5 ft. by suction. The figures in the table refer to vertical pipes; if the pipes are inclined the allowance for friction must be increased. Mr. Beard's table is equally applicable to siphons.

Safe Suction-Head for Pumps at Different Elevations and Various Temperatures of Water.

Elevation Above Sea Level Feet	Atmospheric Pressure Pounds per Square Inch	Barometric Pressure Inches Mercury	Temperature of Water Raised in Degrees Fahrenheit				
			60	90	120	150	180
			Safe Suction-Head for Pump in Feet				
10,000	10·107	20·582	17·0	16·4	14·7	11·3	4·7
5,000	12·224	24·890	20·5	19·9	18·2	14·8	8·2
4,000	12·689	25·837	21·5	20·9	19·2	15·8	9·2
3,000	13·169	26·813	22·4	21·8	20·2	16·8	10·2
2,000	13·665	27·824	23·2	22·6	21·0	17·6	11·0
1,000	14·174	28·861	24·1	23·5	21·9	18·5	11·9
Sea level	14·696	29·925	25·0	24·4	22·8	19·4	12·8
		Lb. per Sq. In.	0·255	0·693	1·683	3·706	7·500
Tension of water vapour at various temperatures.....		Inches Mercury	0·518	1·410	3·427	7·547	15·272

The Distribution of Gold.—*Economic Geology* for May 1911 contains a valuable article by F. C. Lincoln entitled 'Certain Natural Associations of Gold.' The paper is divided into two parts, the first dealing with the recorded occurrences of primary gold in rocks and waters, and the second describing the association of gold with various minerals. The first part collects together the result of the author's and other investigators' enquiries into the presence of primary gold in rocks as distinct from lodes and veins. He tabulates the results, dividing the rocks into igneous, metamorphic, and sedimentary, and gives the figures for the gold contained in various kinds of waters. He includes also records of the presence of gold in minerals of organic origin, such as coal, and in living organisms. In interpreting these records he prefaces the warning that the method of assaying rocks for minute traces of gold is of importance, because the reagent employed is as likely to contain gold and silver as the rocks, a circumstance pointed out in this magazine recently; also that many investigators have taken their samples too near a vein, not fully appreciating the distance to which secondary impregnations may extend. In the records quoted by the author the contents vary widely, the figures for igneous rocks ranging from nothing to 5 grammes per metric ton. After careful consideration of the various cases he takes the average gold content of igneous rocks at 62 milligrammes per metric ton, that is, one grain per ton of 2000 lb., and the silver content at 3741 milligrammes per metric ton or 2·4 dwt. per ton of 2000 lb. He also concludes that the gold favours neither acid nor basic rocks, but that the silver is more plentiful in basic. As regards sedimentary rocks his recorded figures point to an average content of 15 milligrammes or 1 cent per ton and show that the coarser the texture the greater the content. The sea-water is estimated to contain 28 milligrammes. Assuming that the contents of sea-water have been derived from the destruction of igneous rocks, Mr. Lincoln works backward and deduces from the above figures for sedimentary rocks and sea-water that the original content of the igneous rocks must have been 55 milligrammes of gold per ton, a figure not far off his average of recorded investigations. This result agrees substantially with De Launay's generalizations. The author proceeds to show that no magmatic segregation of primary gold in igneous rock has ever taken place, and that no placers of commercial value have ever been produced from the primary contents of eroded igneous rocks. These and other occurrences of gold are discussed in detail and the facts are marshalled in such a way as to lead to a theory of the origin of auriferous lodes, thus: (*1*) gold has not been found in volcanic emanations and its presence in plutonic emanations has only been inferred; (*2*) gold has been found in the circulating waters of the earth's crust; (*3*) there are a great number of valuable deposits of primary gold in geologically young conglomerates, several in geologically old conglomerates, and two known cases in metamorphic rocks; (*4*) there are none in igneous rocks. Presented in this order the facts suggest that the gold of many lodes may have been derived by circulating waters from buried placers, and Mr. Lincoln enumerates the varying sources in order of importance as follows; (*1*) depressed beds of open-textured sedimentaries, (*2*) depressed beds of open-textured tufaceous rocks, (*3*) fractured older lodes, (*4*) fractured compact igneous rocks, (*5*) fractured compact sedimentary rocks. As a specific case he considers that the Tertiary lodes owe their gold mainly to the leaching of pre-Cambrian placers by magmatic or meteoric waters put in circulation by the intrusion of the andesite. The above is a mere outline of an interesting paper that should be studied in detail.

As regards the second part, the association of gold with various minerals, the collection of data has been done with equal care. He shows that in sedimen-


1st Drop
2nd Drop
3rd Drop
Fresh water supply drawn from Simpson Lake
Distance 2000 ft. Elevation 34 ft.
Return to Flue dust
Residue to waste drain to Edwards Lake
Settling water

FLOW SHEET OF THE DOME PLANT, PORCUPINE.

tary rocks gold is frequently associated with the heavier and less soluble constituents, and in metamorphic rocks with magnetite; also that the gold in igneous, metamorphic, and sedimentary rocks is in the form of native gold in grains. In veins gold is found associated with at least 173 mineral species, but of these there are only a few which when present with the gold are more apt than not to contain intergrown and disseminated gold. These are quartz, opal, roscoelite, magnesite, pyrite, galena, hessite, altaite, calaverite, tetradymite, selenium minerals, löllingite, arsenopyrite, bismithinite, aikinite, and bismuth. It will be seen that these are either nonmetallic minerals, the two common sulphides, or contain bismuth, arsenic, selenium, or tellurium. The latter four substances are closely associated in the periodic system and widely removed from gold.

Treatment Plant at the Dome Mine, Porcupine.—The *Mining and Scientific Press* for May 20 gives the flow-sheet of the plant designed by the Merrill Metallurgical Co., of San Francisco, for the Dome Mines Co., at Porcupine, Ontario. The plants hitherto erected in this new gold mining district have been of an experimental or makeshift nature, and that now being erected at the Dome is the first of permanent importance. The ore raised from the mine at (*1*) goes to gyratory crushers (*2*) and (*3*), and then by belt (*4*) to the stamp-mill bin (*5*). There are four batteries (*6*) of 10 stamps each, the stamps weighing 1250 lb. and dropping 102 times per minute. The pulp, after passing over amalgamating plates (*7*), goes to Dorr classifiers (*8*), from which the fine goes to secondary amalgamating plates (*10*) and the coarse to tube-mills (*9*), the discharge from which is returned by means of Frenier pumps to the Dorr classifiers. The tailing goes through concentrating cones (*12*) and Dorr thickeners (*13*), the water being returned by the pump (*16*), and the pulp sent to four continuous agitator-vats measuring 8 by 40 ft.; thence to Dorr thickeners (*18*). The overflow from the latter goes to the tank (*19*) and thence through the Merrill clarifying press (*20*), while the thick pulp goes to Merrill slime presses (*21*). The strong barren-solution tank is at (*27*), and the weak barren-solution tank at (*33*). The strong-solution precipitating-vats are shown at (*22*) and the weak-solution precipitating-vats at (*28*), and the corresponding Merrill precipitation-presses at (*24*) and (*30*). (*23*), (*29*), (*26*), (*32*) and (*36*) are pumps; (*25*) and (*31*) are barren-solution sumps; flushing water for the filter presses is obtained from (37), and the water is recovered in Dorr thickeners (*34*).

CURRENT LITERATURE

Mine Book-keeping.—In the *Mining and Scientific Press* for June 3, K. C. Parrish gives a system for book-keeping at prospects and small mines, that can easily be amplified as the work increases.

Dust Collector for Mines.—The *Iron and Coal Trades Review* for May 26 describes an apparatus for collecting dust from the floors and timbers of mines. A tank travels on the rails, and a suction hosepipe and nozzle held and directed by boys draw in the dust. The suction may be created by a fan driven electrically or by means of a jet of compressed air acting as an ejector.

Prospecting for Iron Deposits.—In the *Engineering and Mining Journal* for June 10, R. S. Archibald discusses the method used in the Lake Superior iron region of prospecting for ore deposits.

Tippett's Stope Drill—In the *South African Mining Journal* for May 6, E. M. Weston gives some information about the so-called "New" drill invented by E. Tippett, an Australian engineer employed on the Rand. It is a small drill intended specially for sinking shafts and winzes. The holes are kept full of water and the hydraulic pressure helps the return of the drill at the back stroke and removes the broken rock rapidly. This arrangement obviates one of the drawbacks of the hammer drill. Additional information will be awaited with interest.

Crosse's Fine-Grinder.—The *South African Mining Journal* for May 27 contains a description of A. F. Crosse's grinding machine for reducing pyrite concentrate to slime.

McLeod Concentrator.—*The Mining World* (Chicago) for June 10 describes McLeod's concentrating table which has been used for some time in Montana.

Electrolytic Cyanide Regeneration.—In the *Engineering and Mining Journal* for May 27, J. E. Clennell describes experiments undertaken with a view of preventing the loss of cyanide by means of regeneration with the electric current. His results were not encouraging, but his paper is valuable in a negative way.

Agitation Vats.—In *The Mining World* (Chicago) for May 27, A. Grothe controverts some previously published criticisms of the Pachuca vat, and explains the efficiency of the work of the vat in continuously exposing fresh surfaces of mineral to the action of the solvent.

Slime Treatment at Kalgoorlie.—In the *Mining and Scientific Press* for June 3, M. W. Von Bernewitz describes the methods of slime agitation employed at Kalgoorlie.

Amalgamation on the Rand.—In our May issue we recorded that at the April meeting at the Institution of Mining and Metallurgy a paper was presented on amalgamation practice on the Rand by W. R. Dowling. To prevent future misconception as to the origin of this paper, we ought to mention that it was previously read at the March meeting of the Chemical, Metallurgical, and Mining Society of South Africa.

Dredging in New South Wales.—The *Australian Mining Standard* for May 4 publishes an abstract of the official reports on the production of gold and tin by dredging in New South Wales.

Rankin's Process for Treating Sulphide Ores.—The *Engineering and Mining Journal* for June 17 shortly describes H. D. Rankin's process for treating sulphide ores of all sorts, starting by sulphatizing the sulphides by means of nitric acid. A plant has been erected at Lake City, Colorado.

Midvale Lead-Zinc Plant.—In *The Mining World* (Chicago) for May 6, 13, and 20 Leroy A. Palmer describes the Midvale lead-zinc concentrator, Utah, with special reference to the Huff electrostatic separator for removing the zinc and iron.

Sintering Experiments.—In the *Engineering and Mining Journal* for June 17, A. W. Hahn describes some experiments undertaken at the Reforma smelter, Guerrero, Mexico, by R. L. Lloyd, for the purpose of sintering flue-dust, speiss, lead matte, etc., by means of a down draught.

Development of the Blast-Furnace.—The *Engineering and Mining Journal* for May 27 contains an illustrated paper by E. P. Mathewson, tracing the development of the blast-furnace for treating copper ores from primitive days to modern times.

Metallurgy in the Harz.—In the *Engineering and Mining Journal* for June 3, O. H. Hahn commences a series of articles on the metallurgy of the complex sulphide ores in the Harz mountains, Germany.

Electric Smelting of Iron Ore.—The *Iron and Coal Trades Review* for June 9 and 16 contains a detailed account of the results obtained at Trollhattan, Sweden, with the electric furnace for smelting iron ore.

Vanadium Alloys.—The *Journal of the Franklin Institute* for June contains a lengthy paper by George L. Norris on the production of ferro-vanadium, and on the manufacture and properties of vanadium steel and vanadium bronze.

Estimating Sulphide in Cyanide.—Sodium cyanide always contains small quantities of sodium sulphide which is usually considered deleterious in gold extraction. E. C. Rossiter, at the Birmingham meeting of the Society of Chemical Industry, held in March, discussed at length the three known ways of estimating this sulphide.

Zinc Oxide in Chemical Glass-Ware.—In the *Engineering and Mining Journal* for June 3, A. M. Smoot shows that zinc is sometimes unexpectedly obtained in analytical results ; he finds that it comes from the refractory glass sometimes used, that contains zinc oxide as a part substitute for lime.

Determination of Alumina.—In the *Engineering and Mining Journal* for June 3, T. W. Cavers describes the method used at the Tennessee Copper works for determining alumina in ore, slag, etc.

Hydrolysis in Geological Chemistry.—In *Economic Geology* for May, Roger C. Wells contributes a paper explaining the principle of hydrolysis, and showing how the presence of water under certain circumstances of pressure and temperature may have an important influence in the reactions causing the deposition of minerals and metals.

Origin of Graphite.—In *Economic Geology* for May, A. N. Winchell describes the occurrence of graphite at Dillon, Montana, and discusses the theories of its formation.

Surface Indications of Ore-Shoots.—In the *Mining and Scientific Press* for May 20, F. L. Ransome contributes to the discussion on this subject previously started by W. H. Storms.

Quicksilver Deposits in Texas.—In *The Mining World* (Chicago) for May 13, J. A. Udden describes the geology of the quicksilver deposits in the Zerlingua district, Texas.

Conditions in Honduras. — In the *Mining and Scientific Press* for May 27, Rensselaer H. Toll contributes an article on travel and mining in Honduras.

Globe, Arizona. — The *Mining and Scientific Press* for June 3 publishes an article by F. L. Ransome on the geology of the Globe copper district, Arizona.

Water-Power in Norway.—At a meeting of the Faraday Society held on May 2, A Scott Hansen, of Christiania, read a paper describing the application of water-power in Norway. He estimated that the prices charged for power at the stations is only from 22 to 44 shillings per horse-power-year. The resources in the way of falls and storage lakes are unrivalled and the indications are that in the near future many important industrial developments will take place.

Tampico Oilfields.—In the *Engineering and Mining Journal* for May 13, Sydney H. Ball describes the oil resources between Tampico and Tuxpam, Mexico. The subject was treated by H. S. Denny in our issue of July 1910.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be supplied on application to The Mining Magazine.

BOOKS REVIEWED

THE STUDENT'S LYELL. Edited by J. W. Judd. Second edition. Cloth octavo, 710 pages, with 736 illustrations. London : John Murray. Price 7s. 6d. For sale by *The Mining Magazine*.

Eheu fugaces labuntur anni! It is 80 years since Lyell published his 'Principles of Geology,' and 75 have elapsed since his 'Elements' appeared. In 1871 he recast the latter as the 'Student's Elements' After his death, Professor Judd, an old and valued friend, carried forward the study of geology from Lyell's point of view, and in 1896 published the first edition of the book which is the subject of this notice. We have often expressed our doubts as to the wisdom of issuing revisions of great books whose authors are dead and gone. We make an exception in this case, because Mr. Judd by old associations is so well fitted to keep the spirit of Sir Charles Lyell still with us.

The second edition of the 'Student's Lyell' is rendered valuable by the addition of an introductory chapter discussing the influences and preparations incidental to the birth of the line of thought which is outlined in Lyell's 'Principles.' It revives memories of the early study of geology in its application to the gradual developments of the inorganic and organic kingdoms, otherwise the history of the world. The controversies of Hutton and Werner, and the gradual transition of Lyell's studies from entomology to botany and zoology and then to geology, are authoritatively recorded. Lyell's 'Principles' established order out of chaos and prepared the way for the theory of Evolution, all the great pioneers of which, Darwin, Wallace, Hooker, Huxley, and Haeckel, always warmly acknowledged their indebtedness. Lyell's sphere was paleontology, not ore deposits ; but none the less his books demand a place in the library of the economic geologist.

JOURNAL OF THE INSTITUTE OF METALS, VOL. V. Paper covers, 420 pages. Illustrated. London : The Institute of Metals. Price 21s.

This volume contains a report of the half-yearly meeting held in January. The most important paper is that on Corrosion of Metals by G. D. Bengough. Over one-third of the volume is occupied with abstracts of papers published by the world's technical Press, during a period of six months, on the occurrence and treatment of the non-ferrous metals. We are grieved to find that *The Mining Magazine* and the *Mining and Scientific Press* have not published anything worthy of record during that time.

OPERATION OF THE GOLDFIELD CONSOLIDATED MILL. By J. W. Hutchinson. Pamphlet, 20 pages. Illustrated. San Francisco : *Mining and Scientific Press* ; London : *The Mining Magazine*. Price 2s.

This is a reprint of a series of articles that appeared in the *Mining and Scientific Press* during May and June. It gives full practical details of the work done at one of the most modern all-sliming plants, and will be of great help to the cyanide metallurgist. We give an outline of the scope of the paper in Precis of Technology this month.

THE DAVIS HANDBOOK OF THE PORCUPINE GOLD DISTRICT. By H. P. Davis. Paper covers, 130 pages, with many maps and illustrations. New York : H. P. Davis, 25 Broad Street. Price 4s. 6d.

This pamphlet contains a complete account of the Porcupine goldfield, its discovery and development ; also of all the companies and individuals operating there.

COMPANY REPORTS

Taquah Mining & Exploration.—This company is now one of the Oceana Consolidated group of West African gold mines. It operates the Taquah mine and owns a large share in the Abosso farther north on the same line of banket deposit. For some years both of these mines were under the management of G. A. Stockfeld. A few months ago Mr. Stockfeld's services were transferred to the West African Trust, a development company belonging to the same group, and J. W. Newbery succeeded him. R. Recknagel and S. R. Adams then examined the mines, re-estimated the ore reserves, and made suggestions for the modification of mining methods and the improvement of the power-plant. More recently W. R. Feldtmann has been appointed consulting engineer. In June 1910 a serious accident occurred in the main shaft and mining operations had to be suspended. It was decided not to resume mining and milling, but to push ahead with development work. Owing to these alterations and reorganizations it has not been possible to issue the report for the year ended June 30, 1910, until now. It shows that during the year 65,222 tons of ore yielded 39,220 oz. gold, worth £166,553, or 51s. per ton. The working expenses in West Africa and London were £109,546; £28,534 has been written off for development redemption, £30,422 allowed for depreciation, £9416 and £3529 written off the shaft-sinking account and exploration account respectively. On February 28, Mr. Recknagel estimated the ore reserve at 102,370 tons, averaging 78s. 3d. per ton; he rejected 107,370 tons which he considered unprofitable.

Abosso.—In continuation of the preceding paragraph we give some information contained in the Abosso report for the year ended June 30, 1910. During that period 77,623 tons of ore was sent to the mill, and by amalgamation and cyaniding 41,125 oz. gold was recovered, worth £174,834, or 45s. per ton. The working profit was £51,196, out of which £14,310 has been written off for depreciation and for shaft extensions, and £5894 has been paid in taxes, leaving a net profit of £30,991. The year commenced with a balance of £31,203, and dividends amounting to £60,000 have been distributed during the year, being at the rate of 15%, leaving a balance carried forward of £2194. An additional 50 stamps are now being erected, as also is an electrical pumping-plant at the main shaft. When the latter is at work sinking will be re-commenced. On February 28, Mr. Recknagel estimated the ore reserve at 284,028 tons, averaging 47s. 3d. per ton, and 58,210 tons, averaging 19s. 9d. per ton.

Prestea Block A.—Two years ago additional working capital was supplied for this West African gold mine by Wernher, Beit & Co., the Consolidated Gold Fields, Fanti Consols, and the United Exploration Co. Milling was suspended, development work was actively conducted, and additional plant provided. The report now issued covers the year 1910, and shows that on December 31 the ore reserve was 678,859 tons averaging 43s. 10d. per ton. The main shaft is down 624 ft. and the Appantoo 724 ft. The report is accompanied by a vertical section of the mine showing the blocks of ore and their average assay-value. The directors record with satisfaction the completion of the railway to Prestea at the beginning of 1911. Of the new 110 stamps, 60 have been erected, and 40 started crushing at the beginning of May this year. During 1910 an additional 150,000 shares were issued at a premium of £53,750, which amount has been set against depreciation of plant and buildings. In January a resolution was passed increasing the capital from £850,000 to £1,150,000, but the new shares have not yet been issued. Out of the new shares, 199,877 are to be paid to the Prestea Mines for the purpose of acquiring the property of that company adjoining that of Block A.

Talisman Consolidated.—This company was formed in 1899 to acquire a gold mine near the Ohinemuri river in the province of Auckland, New Zealand, and in 1904 it was reconstructed in order to purchase the neighbouring Woodstock property. Dividends were first paid in 1906 and since then the profits have been large and increasing. About a year ago important discoveries of rich ore were made on the lowest level. Bewick, Moreing & Co. are the managers, and H. Stansfield is the superintendent. The report for the year ended February 28 shows that 45,850 tons of ore was milled, yielding 43,687 oz. gold and 186,240 oz. silver, which realized £207,874, or about £4. 12s. per ton. The cost in New Zealand and London was £85,337, taxes absorbed £9468, and £2762 was allowed for depreciation. The dividend distributed was £100,447. During the last two years much money has been spent in new plant, particularly pumps and tube-mills. Some of the funds have been supplied out of profits, but it was decided last summer to provide the remainder by the issue of 45,000 new shares at 25s. each. These were readily absorbed and the capital now stands at £345,000. Since 1906 the total distribution of dividends has amounted to £534,228. Mr. Stansfield reports that during the year the ore developed has been about equal to that sent to the mill, and assays £6 per ton.

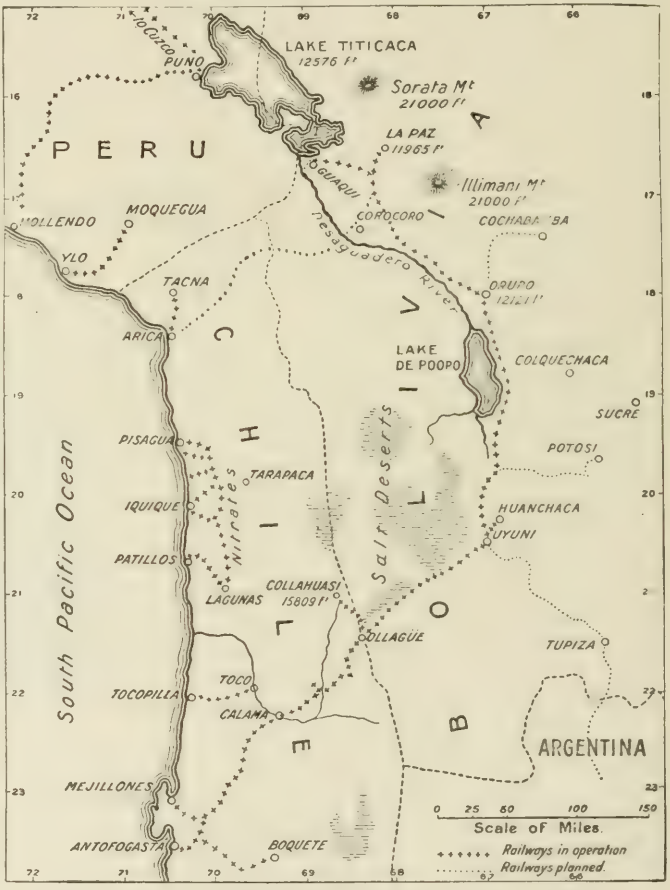
Talisman Mill.

Great Fingall.—In our issue of June last year, we recorded that this gold mine situated at Day Dawn, West Australia, after having been an important producer from 1900 to 1908, came to the end of its main resources and since then operations have been restricted. The report for 1910 shows that development work is still being actively conducted and some profitable ore has been disclosed in the lower levels. Only 40 of the 100 stamps are now at work and during the year they milled 125,871 tons, which by amalgamation and cyaniding yielded 35,978 oz. In addition the new filter-press plant treated 128,149 tons of accumulated slime, and extracted 8822 oz. The income from the sale of gold was £191,100 and the working profit was £33,417. Out of this £6459 was allowed for

depreciation and £5316 was paid as taxes. The dividend absorbed £25,000, being at the rate of 20%. No estimate is given of the broken ore, of the ore in pillars, and of ore in the lowest levels, but it is stated that the last-named source promises to be an important one. A year ago shares were bought in the Taquah Central Mines, West Africa. So far the development work done on the property has revealed no profitable ore. Bewick, Moreing & Co. are the general managers.

Great Boulder Proprietary.—Though other mines at Kalgoorlie have their troubles, the Great Boulder Proprietary has so far escaped these worries. For fifteen years its success has been uninterrupted, and the report for 1910 shows as yet no cloud on the horizon. During the year, 195,407 long tons of sulpho-telluride ore was raised and treated, yielding gold worth £220,961 by amalgamation, and £366,947 by cyaniding, making a total output worth £587,908. The profit was £326,560, out of which £29,950 has been paid as taxes, £30,000 placed to depreciation, and £262,500 distributed as dividend. The working cost per long ton was 26s. 2d. or 23s. 3d. per short ton. These results are much the same as in 1909. During 1910, 5541 ft. of development work was done and the reserve was increased by 9100 tons, standing on December 31 at 760,177 long tons, averaging 15 dwt. Sinking has been continued at the Main and Edwards shafts, the former being now 2844 ft. deep and the latter 2842 ft. The two have been connected at 2500 ft. Richard Hamilton, the manager, reports that indications at depth are good, and that the exploration of the northerly extensions of the main orebody are giving promising results. Boring operations have at the 2800 ft. level proved the existence of two parallel veins of excellent value.

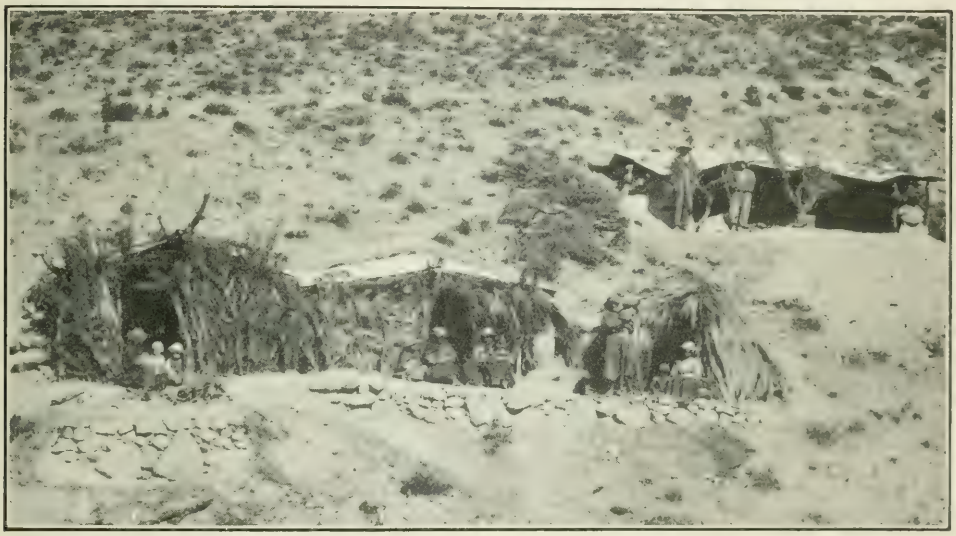
St. John Del Rey.—This company owns the Morro Velho gold mine in Minas Geraes, Brazil, and has just completed the 80th year of its existence. The mine is notable because it is the deepest in the world. Since giving an account of the last half-yearly report in our issue of December last another level has been opened up at a vertical depth of 4600 ft. below adit or 4296 ft. below the surface; already 474 ft. of driving has been done on this level and some ore has been stoped. The report for the year ended February 28 shows that mining, milling, and development work has given satisfactory results and the only adverse circumstance was the insufficient supply of water power owing to drought, and the consequent extra expense on steam power. The amount of ore raised was 193,195 tons, of which 189,600 tons was sent to the 130-stamp mill. The yield by amalgamation and cyanide was 98,726 oz. realizing £421,178 or 44s. 4d. per ton. The working cost was £265,058 or 28s. per ton, development £12,387 or 1s. 4d. per ton, and London expenses £3692. In addition £43,057 was allocated to capital expenditure; £5425 was paid as interest on debentures, £10,000 as dividend on preference shares, being at the rate of 10%, and £50,078 was distributed on the ordinary shares, being at the rate of 1s. 10d. per share, an increase of 2d. per share as compared with the previous year. The reserve fund invested in high-class securities has been re-valued and now stands on the books at £96,472; it is used in part to improve the financing of drafts between England and Brazil. As usual the manager, George Chalmers, gives a full account of progress. A new unit of water power from the Peixe river will shortly be at work and will provide an additional 1000 hp. He also reports that the additional ventilating plant is nearly ready. By its means it is expected that the temperature of the working faces will be reduced sufficiently to make it possible to mine down to 6500 ft. The question of ventilation has received close attention and the experiments made to ascertain the temperature of the rocks are of considerable interest. Reference to this subject is made in our Précis of Technology. The ore reserve is estimated at 1,158,560 tons, or sufficient for five years' work. Owing to the nature of the methods of mining, no further development will be possible for two years, until the 17th and 18th levels are fully opened. We refer our readers to the excellent vertical section of the workings which appeared in our issue last month.



Parts of Chile and Bolivia showing position of Poderosa Mine at Collahuasi.

Poderosa.—In our issue of November last we gave an abstract of the first annual report of this copper

mining company covering the year 1909, and recorded the history to date. In the October number immediately preceding we published an article describing the mines written by the first manager Robert Hawxhurst. The mines are in the Andes at Collahuasi, Chile, not far from the Bolivian border and are situated 15,000 ft. above the sea. The position is shown in the accompanying map and we also give an illustration of native huts. The ore deposits are rich in copper. The directors made the initial mistake of declaring large dividends without reckoning on the necessity of providing funds for further development, and consequently the company soon arrived at a critical position. The directors chose to throw the blame on Mr. Hawxhurst, but most of them have thought fit to resign and make way for others. C. H. Macnutt was appointed manager in the meantime and he took control in the middle of



NATIVE MINERS' HUTS IN THE ANDES.

1909. The report for 1910 now issued shows that the first half of the year was occupied in reorganization of operations at the mine and the output was curtailed. By the middle of the year it was possible to increase the output. The total amount of ore raised during the year from the three different workings, Poderosa, San Carlos, and Rosario, was 28,530 tons averaging 17·8% copper, 21,442 tons averaging 4%, and 5102 tons averaging 2½%. The deliveries of first class ore were 21,797 tons averaging 22% copper and 7·8 oz. silver, shipped from Mejillones, and 1544 tons averaging 13% copper and 4·2 oz. silver shipped from Antofagasta. Some of this ore delivered came from the dumps, to the extent of 3400 tons some of which averaged 25% copper. Development during the year exposed 17,180 tons averaging 23% copper, and on December 31 the ore reserve was estimated at 35,000 tons averaging 22% copper and 7 oz. silver. The dumps are reported to contain 96,000 tons averaging 4·7% copper. In September Mr. Macnutt started to concentrate the dump-ore by means of hand-jigs and sluice-boxes and their work has already proved profitable. Owing to shortness of funds Mr. Macnutt has not been able to do as much prospecting work as is desirable, but now that the evil effects of premature distribution of dividends has been counteracted, he intends to conduct development work on a large scale in the near future. During 1910 the income from the sale of ore was £191,870, and the net profit was £38,471. The year began with a debit balance of £67,272 which is now reduced to £28,801. Since the close of the year the directors have been able to redeem £36,000 of debentures. Experiments have been actively conducted in connection with the concentration of second grade and dump ores and a plant is to be erected.

Rezende.—In our issue of July last year we recorded the earlier history of this gold mine at Umtali, near the eastern boundary of southern Rhodesia, and how after continued failure for 18 years the company had been placed on a more secure footing by the Anglo-French-Farrar group. The expectations then expressed have been substantiated, and the report for 1910 shows a profit of £9015 which has been carried forward. C. R. Pinder is the consulting engineer, and S. R. Jameson is manager. The report of the latter shows that during the year under review 30 stamps crushed 43,800 tons of ore averaging 7·6 dwt., and extracted 8774 oz. gold by amalgamation. The cyanide plant extracted 4541 oz., and 1534 oz. was contained in concentrate that was shipped abroad. The total yield was 14,849 oz., or 6·78 dwt. per ton. The revenue was £64,599, and the working cost £46,975, leaving a profit of £16,624. Part of the property is leased to tributors and an income of £448 was received during the year from this source ; as the tributors' plant has been greatly improved recently and the ore treated is now higher in value, an increased revenue will accrue during the current and succeeding years. From the profit quoted above had to be deducted London expenses, debenture interest, and depreciation. Mr. Jameson reports the ore reserve on December 31 at 112,980 tons averaging 7·58 dwt. together with 17,033 tons of partly developed ore. In addition, in the workings let on tribute 60,427 tons is estimated as developed ; this ore was included in the general estimate last year. A year ago the issued capital was £48,990 out of an authorized £120,000. Since then

18,012 shares have been allotted at par to guarantors of the debenture issue, and 33,501 have been sold at £2. 2s. 6d. With the money thus raised £46,860 of debentures have been extinguished, leaving only £640 outstanding. Many improvements have recently been made in the gold-extraction processes. The most important is the treatment of the rich concentrate on the spot by sliming with mercury in a wheeler pan and then cyaniding the tailing. In this way a 95% extraction can be obtained at a cost of 49s. 6d. per ton including 18s. 7d. left in the residue, as compared with £6. 10s. the cost when shipping the ore.

Geldenhuis Deep.—In 1909 the properties of the Geldenhuis Estate, Geldenhuis Deep, and Jumpers Deep were amalgamated, and the organization continued under the name of the Geldenhuis Deep. The Geldenhuis Estate started work on the outcrop in 1887, and was practically exhausted at the time of amalgamation, nothing but pillars being left. The Geldenhuis Deep commenced operations in 1895 and the Jumpers Deep in 1898. The mill of the combined companies consists of 420 stamps and 6 tube-mills. The company is one of the Rand Mines group, G. E. Webber has been consulting engineer, but is now retiring, and H. Musson Thomas is manager. The report for 1910 shows that owing to the scarcity of labour it has not been possible to reach the maximum output that was expected at the time of amalgamation, the amount treated being 9000 tons per month short. In fact the output of ore was rather less than in 1909, but on the other hand the profit was greater. This is due to the keen application of the principle of not mining and milling waste, which has on many occasions been the subject of papers and discussions by Mr. Thomas. During the year, 1,058,175 tons was raised, and after the removal of 21% waste 827,065 tons was sent to the mill, averaging 7 dwt. The yield of gold by amalgamation and cyanide was 276,002 oz., or 6·68 dwt. per ton milled. The revenue was £1,156,543, or 28s. per ton milled. The cost was £905,238, or 21s. 11d. per ton milled, leaving a profit of £251,305, or 6s. 1d. per ton. During the year, 25,829 ft. of development work was done and the ore disclosed thereby was 1,153,777 tons averaging 5·2 dwt. On December 31 the ore reserve was 2,521,481 tons averaging 6·1 dwt. It will be seen that the ore recently developed is of lower grade than the average reserve; in the western part of the property the grade is discouragingly poor in the lower levels. There is a large amount of ore left in the pillars still to be extracted, but owing to some of the ground being caved it is not easy to estimate its quantity and quality. Sand-filling is being adopted so that these pillars may be recovered. Much money has been spent during the year on improving the power plant and in providing double-stage winding in shafts No. 2 and No. 3.

Durban Roodepoort Deep.—This is one of the Rand Mines group, and the mine is situated in the western Rand. Milling started in 1898, but it was not until 1908 that any dividend was paid. The report for the year 1910 shows that a smaller profit was made than in 1908 and 1909, owing to higher costs. The cost of working at this mine has always been high compared with the average on the Rand. In 1909 it had been reduced to 22s. 9d. per ton milled, but for 1910 it has increased again to 24s. 6d. The cause for this advance was partly the inefficiency of labour and partly the greater amount of development and shaft-sinking done. During the year 309,067 tons was raised and, after the removal of 22% waste, 240,530 tons went to the mill, which consists of 100 stamps and 3 tube-mills. The content of the ore milled was estimated at 7·57 dwt. The yield of gold by amalgamation was 61,894 oz. and by cyanide 23,416 oz., making 85,310 oz. in all, or 7 dwt. per ton milled. The revenue was £357,128, or 29s. 8d. per ton, and the cost was £295,407, or 24s. 7d. per ton, leaving a profit of £61,721, or 5s. 1d. per ton. Out of this, £24,285 has been allocated to capital expenditure on new plant, and £3550 was paid as taxes; the dividend was £33,000, being at the rate of 7½%. During the year, development has been hindered by lack of labour, and consequently the number of feet driven was smaller than was expected, but on the other hand the ore disclosed has been of better value. It is worthy of note that in the case of this mine the content is increasing with depth. On December 31 last the reserve was estimated at 867,551 tons, averaging 6·7 dwt., and in addition the ore left in pillars was 194,426 tons averaging 7·3 dwt. The average content of the ore mined during 1910 was less than it should have been, owing to the bad results obtained by machine-drills. These have since been replaced once more by hand-drilling. A system of ventilating is being installed in order not only to improve the quality of the mine air but to reduce the heat of the workings.

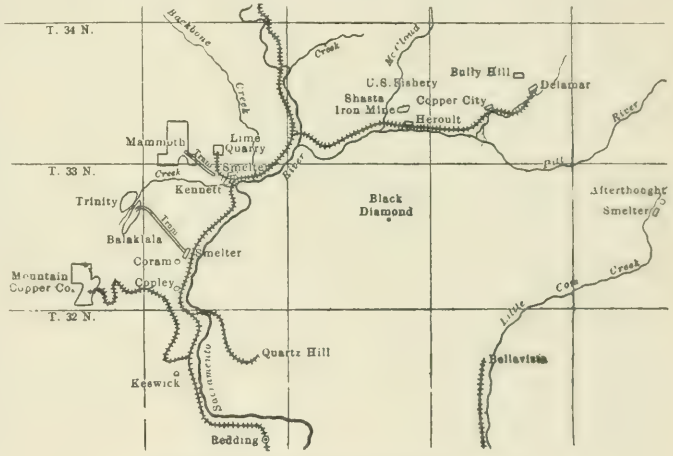
Rose Deep.—This is another of the Rand Mines group, and is isolated from the others, being situated to the east beyond the Consolidated Gold Fields group. It is on the dip of the Primrose, May, and Glencairn. The company was formed in 1894 and milling started in 1897. At the end of 1909 the adjoining Glen Deep was absorbed and the two mines are now worked under one organization. The combined metallurgical plant contains 300 stamps and 7 tube-mills. During the year 1910 mining has been greatly hindered in the old Rose Deep part by caving and by the weakening of the winding shaft. Not only was the output restricted, but much expense was entailed in making good the damage. Consequently the yield was less than normal and the cost higher; the profit was £40,000 less than the combined profits of the two mines in 1909. The amount of ore raised was 761,751 tons and, after the removal of 13·8% waste, 656,954 tons was sent to the mills, the normal annual capacity of which is 765,000 tons. The estimated content of the mill-ore was 6·9 dwt. By amalgamation 147,453 oz. was recovered, and by cyanide 75,454 oz., making a total of 222,907 oz., or 6·8 dwt. per ton milled. The revenue was £934,154, or 28s. 5d. per ton, and the cost £618,878, or 18s. 10d. per ton, leaving a profit of £315,276, or 9s. 7d. per ton. The development work done during the year was 16,230 ft., and 993,512 tons averaging 6·3 dwt. was added to the ore reserve, which on December 31 stood at 3,553,474 tons, averaging 6·1 dwt. The dividend absorbed £280,000, being at the rate of 40%; £25,463 was paid as tax.

Brakpan.—This is a second deep level in the far east Rand and is below the Kleinfontein and Van Ryn Deep. It is controlled by the Consolidated Mines Selection Company; W. L. Honnold is consulting engineer and C. B. Brodigan is manager. Preparations for work have been carefully and thoughtfully planned and the development was conducted on a large scale before any treatment plant was provided. Two vertical shafts have been sunk one below the other on the dip; they cut the gold-bearing strata at 3100 and 3700 ft. respectively, and are connected by an incline. Development has been done on fourteen levels, and to the end of 1910 the footage was 37,744, the ore reserve then being 1,720,181 tons averaging 6·56 dwt. over 52 inches. In recording progress at this mine in our issue of July last year, we mentioned that the mill was to

contain 160 stamps weighing 2000 lb. each, and that the capacity was to be 60,000 tons per month, but that many of the details were not then settled. Part of the plant is now complete and should be in operation by the time this paragraph is published. Air-agitation, Butters filters, and the Merrill method of zinc-dust precipitation have been adopted. Probably the capacity of the plant will be greater than was originally estimated.

Village Main Reef.—The report of this mine, in the central part of the Rand, for the year 1910 is of particular interest, as it gives the results obtained by the adoption of H. F. Marriott's policy of eliminating ore of doubtful profitableness. The company is housed by the Consolidated Gold Fields, but the control and technical direction is with the Wernher-Beit-Eckstein group. The property is on the dip of the Wemmer, Salisbury, Jubilee, and part of the City & Suburban ; in 1906 the first-named was acquired and absorbed. Milling started in 1892 with 10 stamps and the plant has been gradually increased until it now contains 220 stamps and 6 tube-mills. During the last three years the profits have greatly increased. Judging by the reef area the mine may be expected to be productive for four years more. The report for 1910 shows that 588,552 tons was raised from the mine and, after the rejection of 16% waste, 492,446 tons was sent to the mill, averaging 8·84 dwt. The yield by amalgamation was 133,846 oz., and by cyanide 71,247 oz., a total of 205,093 oz., or 8·3 dwt. per ton. A year ago practically the same amount of ore was raised, but only 12% of waste was removed at the surface, and the average content of the ore milled was 7½ dwt. The policy during 1910 was to maintain the output of the mine, but to leave behind more of the low grade ore. The income was £860,839, or 34s. 10d. per ton of ore milled, and the expenditure was £410,433, or 16s. 7d. per ton, leaving a profit of £450,406, or 18s. 3d. per ton. During 1909 the revenue was £787,161, or 30s. 7d. per ton, the cost £394,341, or 15s. 4d. per ton, and the profit £392,820, or 15s. 3d. per ton. It will be seen that though expenses were higher, owing to the greater cost of mining and the smaller tonnage milled, the gross profit and the profit per ton were substantially increased. The ore reserve on December 31 was 1,775,175 tons, averaging 9·2 dwt., as compared with 1,999,784 tons averaging 8·9 dwt. the year before. The 1909 report included much unprofitable rock in the reserve. This has now dropped out, and the amount of ore to be ultimately raised and milled has been reduced. The consulting engineer, H. Stuart Martin, warns shareholders that the life of the mine will be shortened by this policy, and that the monthly yield will be subject to marked fluctuations. The profit mentioned, £450,406, was subject to many deductions, including £31,652 expenditure on electric and sand-filling plant, and taxes £58,100. The dividend was £330,400, being at the rate of 70%, the same as last year, but an additional £40,000 was carried forward.

Mountain Copper.—The report of this company for 1910 discloses an unpromising state of affairs. It will be remembered that the company was formed in 1896 by the Rio Tinto people to acquire the Mountain copper mine situated at Iron Mountain, Shasta county, California, together with a smelter at Keswick. For some years large profits were made and in 1901 the output was 13,270 tons of copper. Subsequently the orebody was found to be of less extent than was originally supposed, so in 1902 the company was reconstructed by changing the shares into redeemable debentures. Owing to persistent smelter-fume litigation, only a small portion of these debentures have been redeemed, and the profits applied to the acquisition of sulphuric acid plant and fertilizer works. In reviewing the progress of the company a year ago we recorded that the profit had dropped to £24,557, which was not sufficient to pay the 6% interest on the £750,000 of outstanding debentures. The report for 1910 gives little specific information except that the result of the year's work was a deficit of £3041. The loss is attributed to the fall in the price of copper, the necessity for writing down the value of the stock in hand, the high cost of production, and the unfavourable course of business in California generally. The board has made special enquiry into the conditions on the spot, and has in consequence decided to close one of the acid works. C. W. Fielding, who originally introduced the property here, has left the board, and Lewis T. Wright has resigned as manager.



Copper District of Shasta County, California.

English Crown Spelter.—This company was founded in 1883 to acquire the distilling works of the Crown Zinc Co. in Swansea, and mines in the province of Bergamo, Italy. The Swansea works treat ores bought in the open market as well as those from the company's mine. During recent years money has been spent on new properties in North Wales and Tunis, but neither has proved a success. The report for 1910 shows that the mine produced 10,260 tons of calamine and blende suitable for direct calcining and roasting, and in addition 12,072 tons of ore was dressed yielding 3033 tons of calamine and blende concentrates. The net profit for the year was £20,120, out of which £5068 has been added to the reserve, bringing that fund to £10,000, £12,600 has been distributed as dividend, being at the rate of 15%, and the balance carried forward. E. Windsor Carlyle is manager of the mine.

McKinley-Darragh-Savage.—This company owns property at Cobalt, Ontario. The McKinley-Darragh mine is on the southwest shore of Cobalt lake, and the Savage is farther to the south, on Cart lake. P. A.

Robbins is manager, and the offices are at Toronto, and Rochester, N.Y. In our issue of June 1909 we gave a history of the venture and recorded that the production of silver for that year was nearly double that for 1908. The report for 1910 now published shows that the production has doubled once more, the yield of silver being 2,639,544 oz., as compared with 1,297,326 oz. in 1909, 718,068 oz. in 1908, 707,543 oz. in 1907, and 42,673 oz. in 1906, the first year of operations. During 1910, 57,653 tons of ore was raised at the McKinley-Darragh mine, of which 26,820 tons was waste, and the remainder sent, together with 6183 tons from the dump, to the mill. The production was as follows : Nuggets containing 12,871 oz. silver ; 303 tons of first class ore containing 671,168 oz. ; 386 tons of jig concentrate containing 741,859 oz. ; 725 tons of sand containing 589,062 oz. ; 669 tons of slime containing 179,639 oz. ; and 124 tons of fine containing 32,167 oz. ; making a total of 2210 tons containing 2,226,766 oz. The ore reserve on December 31 was estimated at 104,450 tons containing 4,894,000 oz. silver. It is proposed to strip the surface of overburden at the most promising points in order to prospect for other veins. The general outlook at the mine continues excellent. At the Savage property 10,583 tons was raised, of which 4312 tons was rejected as waste. The remainder together with 295 tons from the dumps went to the mill at which 15,170 oz. silver was recovered in nuggets together with the following : 137 tons of No. 1 ore containing 303,828 oz. silver ; 58 tons of jig concentrate containing 81,421 oz. ; and 20 tons of sand containing 12,356 oz. ; making a total of 217 tons containing 412,775 oz. silver. The estimated value of the silver recovered at the two mines was $1,426,856 and the cost of mining and concentration was $254,794. The charges at the smelter were $124,596 and other expenses and allowances for depreciation were $70,824, leaving a profit of $976,640 for the year. The report does not state how much of this profit was distributed as dividend.

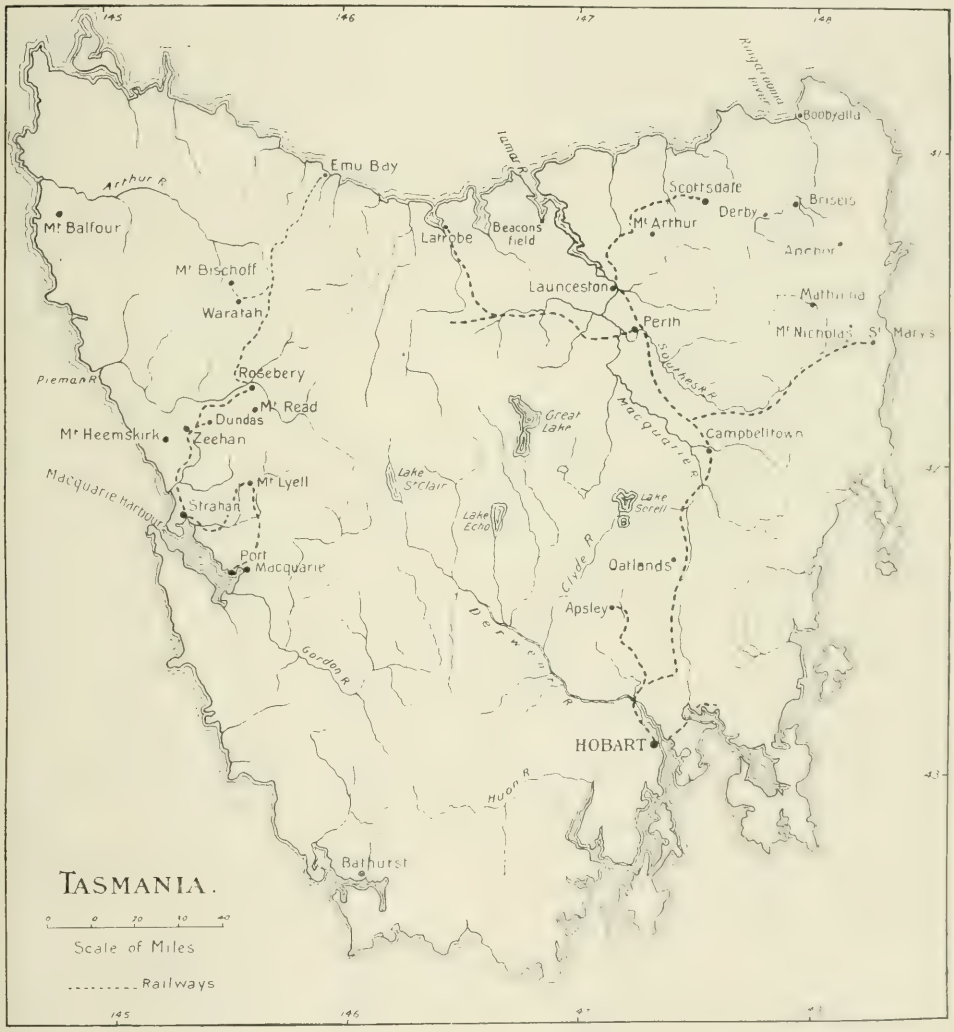
Buffalo.—This mine is situated in the centre of the Cobalt silver district, Ontario, and has paid dividends since 1906. It is not one of the largest producers, but on the other hand is notable as being the first to apply the cyanide process for the treatment of fine sand and slime. The report for the year ended April 30 shows that the output and shipments were much the same as in the previous twelve months. The mining developments would have been expanded if it had not been for the difficulty of obtaining compressed air from the power companies. During the year 33,705 tons from the mine and 7779 tons from the dump was sent to the mill, where the following were produced : 25,795 oz. silver in nuggets, 540,078 oz. in jig concentrate, 632,202 oz. in table concentrate, and 103,321 oz. in cyanide bullion, a total of 1,301,396 oz. or 87% of the estimated content. The cyanide bullion was produced from 11,700 tons of slime averaging 13 oz. per ton, and 67% of the content was recovered. The shipments during the year were 1079 tons of concentrates and 126½ tons of high-grade ore. The revenue from the sale of silver was $829,191 and of cobalt $146, a total of $829,337. From this the cost of freight and treatment, $75,115, was deducted, leaving an income of $754,221. The expenses were $343,297 leaving a profit of $412,889 out of which $370,000 was distributed as dividend and the remainder carried forward. The amount of ore developed during the year was approximately equal to that mined. In the concentration plant, additional tables have been provided for treating the slime before cyanidation. The cyanide plant is being doubled, and within a short time all the fine sand and slime averaging over 6 oz. will be treated. Tom R. Jones is the manager.

Nipissing.—This is one of the largest producers of silver at Cobalt, Ontario. The report for 1910 shows an increase of $480,000 in the profits as compared with 1909. As only half of the property has been prospected it is probable that the life of the mine will continue for a considerable period. During the year the following shipments were made : 1531 tons of high-grade ore containing 3,999,580 oz. silver, 4834 tons of low-grade silicious ore containing 1,008,357 oz. silver, 319 tons of concentrate containing 296,490 oz. silver, and nuggets containing 293,350 oz. The total production was 5,597,778 oz. valued at $2,991,891, as compared with 4,646,876 oz. worth $2,395,430 during 1909. In addition $16,109 was received as credit for cobalt content. The cost at the mine was $816,980, and deductions for cost of treatment by smelters together with freight was $264,692, leaving a net profit of $2,167,103, out of which $2,100,000 has been distributed as dividend. On December 31 the ore reserve was reported to contain 6,553,880 oz. silver, a higher figure than a year ago. This does not take into account the large amount of milling ore on the dumps. Much trenching work has been done during the year, and experiments in connection with hydraulically stripping the surface have also been undertaken. It is intended to continue the latter work and additional plant for the purpose will be provided during the present summer. The report mentions that a trial plant has been erected by Charles Butters for the production of silver bullion from the ore, and that the results are most encouraging.

Zeehan Montana.—This mine was floated in 1892 as a subsidiary of the Mount Zeehan (Tasmania) Silver Lead Mines Co., and for many years did well. In 1908, however, all the available ore appeared to have been exhausted, but as the manager, John Craze, and the Government geologists were of opinion that further exploration work was warranted, developments were vigorously prosecuted. Success rewarded Mr. Craze's efforts and the results for 1909 were encouraging. The report for 1910 now issued shows that the orebodies discovered during the previous year have continued to yield ore, and it has been possible to pay a dividend once more, though only a small one, at the rate of 2½% on a capital of £80,000. During the year, 2908 tons of shipping ore was raised, and 10,316 tons of concentrating ore averaging 11% lead and 11 oz. silver per ton ; of the total product, 2603 tons of ore and concentrate was shipped to Antwerp, averaging 65% lead and 88 oz. silver, and 333 tons was sold to the Tasmanian Smelting Co., averaging 62% lead and 53½ oz. silver per ton. It will be remembered that a year ago a tin property was bought cheaply for cash in the adjoining Dundas tin district. Much exploration work has since been done, and it is reported that the lode is large. Unfortunately, though there are rich patches here and there, the average grade is low. Mr. Craze estimates the developed ore at 200,000 tons averaging 0·4% metallic tin, but he doubts its profitableness. The accounts for 1910 show receipts from the sale of ore £36,126, mine expenses £28,289, administration in Tasmania and London £4075, and other small items, leaving a net available profit of £3171 out of which £2000 was distributed as dividend.

Briseis.—This company was formed in 1899 to acquire a tin-gravel property in the Ringarooma district in the northeast of Tasmania, and shortly afterward a part share was acquired in the adjoining New Brothers Home No. 1, the Briseis company working the property for 58% of the net produce. In 1909, as

the properties were approaching exhaustion, the name of the company was changed to the Briseis Tin & General Mining, and gold-gravel properties in Victoria were acquired. The report now issued covers the year 1910 and shows that in June the No. 1 property and the southern part of the Briseis were finally exhausted. In 1909 the monthly production was 92 tons of black tin. This fell to 67 tons during the first half of 1910 and to 47 tons during the second half. On December 31 it was estimated that the Briseis still contained enough gravel to yield 45 to 50 tons per month for three years. Work has proceeded steadily with the removal of overburden at the Ringarooma property that was formerly supposed to be unprofitable, but no further information has been obtained relative to the tin content of the underlying gravel. The total production of black tin during 1910 was 684 tons as compared with 1102 tons in 1909, and the corresponding figures for metallic tin were 491 tons and 808 tons. Of the 491 tons, 9 was the share of the No. 1 Co. and 482 that of the Briseis. The revenue from the sale was £77,982 or £161. 15s. per ton, as compared with £105,953 or £138 per ton in 1909. As regards the Wallace gold-gravel properties in Victoria, the report shows that the old dredges are just paying their way with a small output of £7972 for the year, and that of the two new dredges one is already at work and the other should be ready shortly. The accounts of the Briseis Co. for 1910 show a profit of £32,125 and dividend distribution of £30,000.



Utah Copper.—The net profits for the year ended December 31, 1910, amounted to $5,401,775. Of this sum $3,890,912 was the profit resulting from the operation of the plants in Utah. After the payment of dividends aggregating $4,648,675, together with interest on a few outstanding bonds, $187, or a total of $4,648,863, there remained a balance for the year of $752,912, which was passed to undivided profits. The total amount standing as a credit to undivided profits on December 31 last amounted to $3,696,539, and is

the amount over and above dividends and interest charges which has been derived from operating profits and income. The surplus, $6,083,980, is the amount received in cash from the sale of stock in excess of the par value thereof. On December 31, 1909, the issued capital stock was 734,375 shares. On December 31, 1910, the total issued capital stock was 1,562,599 shares, an increase during the year of 828,224. This increase was due to the acquisition of the Boston Consolidated Mining Co.'s property, in exchange for 310,000 shares; that of 1,000,152 shares of stock of the Nevada Consolidated Copper Co., 444,512 shares; sales for cash at $50 per share, 73,437 shares; and conversion of bonds. The total authorized stock of the company is 2,500,000 shares. Quarterly dividends were paid during the year at the rate of $3 per share per annum. The total length of all underground work up to the end of 1910, was 63·78 miles, of which there is now accessible 43·35 miles. During the year sixteen drill-holes were driven, the total number of feet drilled being 6209, making a total of all drilling for development purposes on the property of 10,015 ft. The cost of underground development for the year amounted to 7·02 c. per ton on all ore mined and shipped to the mills. The total area of fully and partly developed ground was 166·15 acres. The average thickness of the developed and partly developed ore in this area is 345 ft. The entire orebody has been re-blocked and sectionalized, and the tonnages and values re-calculated upon a basis that is as definite and accurate as the character of the orebody permits. After deducting all ore mined up to January 1, 1911, there remains in the area in which the principal development has been done, 203,500,000 tons of fully and partly developed ore. Of this amount 152,130,000 tons are fully developed and blocked. In calculating ore tonnages, 13 cu. ft. of ore in place is taken as one ton. Of the fully developed ore, 60,000,000 tons has an average copper content of 2%, and the remaining 92,130,000 tons of ore fully developed contains 1·6% copper. The average assay of the partly developed ore is 1·4% copper. The entire 203,500,000 tons developed and partly developed ore contains an average of 1·67% copper. In obtaining these averages, there have been used the samples from 225,722 ft. of drifts, rises, winzes, and drill-holes, the total number of samples taken being 27,186. As a check against the average percentages of copper stated, it is interesting to note that the average assay of the total 11,175,916 tons of ore mined and milled from the Utah and Boston groups, prior to the date of this report, was 1·64% copper. It is estimated that in the extraction of the entire ore reserve stated, the average copper content will fall possibly as low as 1·6%. The average thickness of capping is 105 ft., or a ratio of ore to capping of approximately 3·3 tons of ore to one ton of capping. During the year 1910 the total capping removed was 2,814,764 cu. yd. The total capping removed to January 1, 1911, was 7,162,556 cu. yd. The total area upon which stripping operations have been conducted on both groups, and which is therefore either wholly or partly stripped, is 85 acres. The actual area completely stripped on both groups is 20·87 acres. The total yardage removed from both areas represents the equivalent of completely stripping 41·67 acres of capping, of the average thickness previously stated, for the combined groups. Such an area would contain 56,252,643 tons of ore. The amount of ore removed from the mines is approximately one-fifth of this tonnage. Of the total ore mined during the year, 82% was mined by steam-shovels, and 18% by underground methods. The average cost of mining for the year was 40·97 c. per ton, of which 13·3 c. was charged to cover development and stripping expense, leaving a total cost for producing ore of 27·67 c. per ton. The total cost of producing 20% of underground ore was approximately the same as that of producing the other 80% by steam-shovel methods. The total tonnage treated at all plants for the year was 4,340,245. The average grade of the ore treated at all plants was 1·54% copper, and the average extraction at all plants 66·55%, equivalent to a recovery of 20·51 lb. of copper per ton of ore. The average cost of milling for all plants for the year was 46·63 c. per ton, including proper proportions of all fixed and general charges. The total production of all plant for the year, of copper contained in concentrate, was 89,019,511 lb. The average grade of concentrate produced was 27·28% copper. The average price received for copper sold during the year was 12·672 c. per lb. The average cost per pound of copper produced, based on the net pounds of copper resulting after smelting deductions and allowances were made, and after applying credits for the gold and silver recovered, was 8·069 c., as compared to 8·787 c. for the year 1909. This cost includes all expenses of smelting, refining, transportation, and selling the metal. The average cost of production at the Magna plant for the period, and on the same basis, was 7·8828 c. per pound. The cost of mining and milling, exclusive of transportation, was 87·6 c., as compared with 94·43 c. for the previous year.

TRADE NOTES

Most of the trade publications mentioned in this column are available for distribution and the manager of "The Mining Magazine" will be pleased to secure copies for persons interested

A. C. Wells & Co. describe their acetylene lamps in a six-page folder.

The Alexander Milburn Co. send us a 48-page catalogue describing their various types of acetylene lamps. The reader cannot help but be impressed with the splendid array of letters from satisfied users.

Bowes, Scott & Western devote a special folder to the description of their sand and slime pumps. The special features mentioned are the simplicity and easy access to wearing parts.

International Channelling Machines, Ltd. have issued a catalogue describing the Siskol Stope Drill. This drill tied for first place in the recent South African tests, and received a prize of £2500. A short and interesting summary is given of the drill trials. The makers give full details of the construction and action of the drill, and the purpose of the catalogue is evidently to give every facility to the possible user to study each feature of the machine. Very few catalogues give such complete information.

The Bucyrus Co.'s Placer Dredge Catalogue (8 by 11 in., 86 pages) makes good reading. The generous size of the pages allows large photographs to be reproduced without obscuring the details of construction Well executed line drawings give a good idea of the general arrangement of the operating and gold-saving machinery. An imposing list appears of 80 dredges equipped with Bucyrus machinery. It is interesting to note that the Continental Dredge in Oroville built in 1899 and still in commission, was the first of the close-connected bucket type now almost universally adopted on American-built dredges. It is claimed that one of the Bucyrus 15 cu. ft. dredges has dug 325,000 cu. yd. in one month and averaged 275,000 per month for one year.

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Scientia non habet inimicum nisi ignorantem.

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REVIEW OF MINING

INTRODUCTORY.— The hot weather, the summer holidays, the Moroccan crisis, and the domestic political situation have had a cumulative effect in causing stagnation in the mining markets. But conditions are healthy. Money is plentiful, good news has preponderated over discouraging items, and the technical position is excellent. Even mines that are shaky are being supported by plucky shareholders, so that bear raids are highly dangerous. No large bull accounts exist.

At the end of July some uneasiness was caused by rumours affecting the Yorkshire Penny Bank. This old and reputable savings bank was in a bad way. Only the prompt intervention of the Bank of England prevented a collapse that would have caused an unpleasant shock, coming so soon after the Birkbeck failure. However the situation was saved, fresh capital was provided, and serious trouble averted.

The Kaffir market continues sluggish. Decreased dividends have discouraged investors. Some of them feel that they get too little consideration from the big operators. Business is more evident in Rhodesians, which are subject to moderate fluctuations. This, however, is no investor's market; it offers a lively gamble to the cheerful plunger and to the well informed speculator. West Africans are dull, pending actual results from new plants. Broken Hill shares have attracted attention and dealings have been lively, especially in British, South, and Block 14. Porcupine issues have been depressed by the fire, but interest in this new goldfield has spread and several important houses have sent engineers to investigate.

TRANSVAAL.—The statistics for June enable us to compare the first half of 1911 with the same period of 1910, the total yield of gold being worth £16,889,615, which is £1,382,277 or 8¼% more than in the corresponding period last year. The July statistics are noteworthy as the monthly output has for the first time exceeded 700,000 in ounces and 300,000 in pounds sterling; the exact figures being 709,258 oz. and £3,012,738, of which 679,881 oz. came from the Rand and 29,377 from elsewhere. Up to the end of June the gold production of the Transvaal, since 1884, had reached the gigantic total of £337,102,700 or one quarter of the world's production during the entire 27 years. It is interesting to note that, according to the report of the State Mining Department, the development work done in the mines of the Transvaal in May aggregated no less than 97,490 feet or more than 18 miles of underground working. Only 9000 feet is credited to mines outside the Rand. An increase in rock-drills is shown, the number being 4201 as against 3851 in January. The tonnage hoisted was 2,517,136. The milling equipment is represented by 10,095 stamps and 225 tube-mills, of which 9470 stamps and 212 tube-mills are within the Rand area. The base-metal production in May amounted to 352 tons, worth £59,402, as against £32,508 in January.

These statistics are all satisfactory and the only item to check optimism is the decline in the supply of labour. During June the decrease was 3447, that is, from 209,196 to 205,749 natives. This came on top of a decrease of 3936 in May. Now we have the figures for July, showing a further loss of 4991, so that the total is 200,758 natives, as compared with the 201,672 employed at the same date last year. The fluctuation is normal, but it is apparent that the efforts to recruit a larger supply have availed but little. An increased demand is faced with a supply that is practically unchanged. Reasons for

this shrinkage, apart from the seasonal migration, were given in these pages last month.

During the first half of 1911 the mines of the Witwatersrand yielded 11,444,176 tons from which a profit of £5,643,148 was obtained. During the same period the dividends aggregated £4,084,817. In 1910 the total profit was £11,216,105 and the total dividends £8,875,000. This suggests that the term 'profit' is generous; in other words, that only 80% of the so-called 'profit' reaches the shareholders. Some of the 20% is expended in improvements, in plant and machinery, in bonuses to directors, in sundry and extraordinary expenses, but these expenditures are just as essential as the money spent in labour and advice, fuse and caps, postage and stationery.

In the latter part of July a flutter was caused by the Johannesburg correspondent of *The Financial Times* cabling that several of the Eckstein mines would revert from electric power to steam. This seemed a curious reaction and elicited a prompt correction from the Central Mining office. It appears that the supply of electric power is inadequate owing to the increased substitution of electric for steam power; at the same time the supply of compressed air from the Rand Mines Power Supply Co., to the mines controlled by the Rand Mines Ltd., has been delayed by the non-completion of the entire plant, but the 4000 hp. compressors at work are doing excellent service. As Mr. George Albu only recently stated at the New Goch meeting that the saving through the adoption of electric power as against steam was 7'28 pence per ton milled it would indeed be surprising if this line of progress were to be abandoned.

The Brakpan figures for July were well received. The yield and profit are both good, and the latter will be better when the cost becomes normal. The estimate of ore in reserve is also excellent, showing distinct gains both in quantity and quality.

RHODESIA.—The British South Africa Company gives 50,890 ounces, worth £215,347, as the gold production in June. This is a slight increase as compared with May, but less than March and April. For the six months the total output was £1,290,961 as against £1,327,591 in the first half of 1910. Among the various productive mines the Globe & Phœnix holds first place with 10,401 oz. from 6501 tons, this being a slight gain. The Rhodesian Corporation and the Selukwe Columbia also exhibited improvement in June.

In the latter part of July the Rhodesian market was cheered by excellent news from the Shamva, Lonely, and Eldorado mines. The manager of the Shamva cabled that five feet of 4 oz. ore had been cut in a drift on the second level, besides other high-grade ore elsewhere on the same level. This points to a considerable sweetening of the low-grade stuff on which the enterprise is founded. At the Lonely Reef the sixth level is showing well as compared with the fifth, and the lode has been cut on the seventh, exposing 4½ feet of 2 oz. ore. The new plant also started on July 1st, so that bigger returns may be expected. At the Eldorado Banket mine the bottom or eighth level is full of promise, an assay of 5 oz. for a width of 6 ft. being announced at the place where the lode was first cut. This has been confirmed by a later cablegram, indicating that the rich ore continues and shows visible gold freely.

Shareholders in mining companies who reject the advice of their consulting engineers deserve scant sympathy. We have none for the speculators in Selukwe, for they persisted in spending money in further development after Messrs. A. H. Ackermann and H. Ewer Jones had plainly advised them to desist. The Selukwe has given many unnecessary spasms to the share market; its obsequies call for no further delay.

A good impression was made by the publication of an estimate of ore in reserve in the

Globe & Phœnix mine, the figures being 179,040 tons averaging 36 dwt. on June 30, as against 181,137 tons averaging 35·2 dwt. on March 31. The sinking of the exploratory winze from the 16th to the 18th level is to be resumed.

Census returns show that the white population of Southern Rhodesia is 23,582, as against 12,596 in 1904. Salisbury has 3479 and Bulawayo 5200 inhabitants. In the whole of Rhodesia about 20,000 white men control the industrial activity of 2,000,000 natives.

On August 10 the manager of the Tanganyika Concessions sent a cablegram concerning the trial-run with the first blast-furnace. Some copper is being produced, under difficulties. Until detailed information is available, it is impossible to conclude whether the experiment is a success.

WEST AFRICA.—The output of gold for June was 22,555 ounces, worth £92,174, this being a slight decrease on May but still far above the average. The total for the half-year is 111,688 oz. valued at £456,324 as compared with 185,493 oz., worth £755,985, for the whole of 1910. The increase is noteworthy, but less than might have been expected. In June the Prestea duplicated its May output, although a larger return was expected. The Ashanti Goldfields is still easily the chief producer, with £41,360 worth of gold from 9933 tons.

Our information from the Gold Coast indicates that the Prestea has had a series of troubles and that its estimated prosperity may be further delayed. Even the 50 stamps have not been continuously employed and it is unlikely that ore for the full complement of 110 stamps can be furnished for some time to come. The vein has a graphitic casing on the hanging wall; this comes away when the quartz is broken and necessitates a tedious process of filling, for which proper facilities have not been provided. The failure of the supply-pump on the river caused some annoyance and a miscalculation in the capacity of the electric motors has resulted in an overheating that entails interruptions to regular work. At the Taquah and Abosso mines a distinct improvement is reported, the co-operation of Messrs. J. W. Newberry and W. R. Feldtmann having given a better tone to the entire administration. The managers of the two mines, namely L. C. Stuckey and G. C. Campion, are highly regarded by those on the spot.

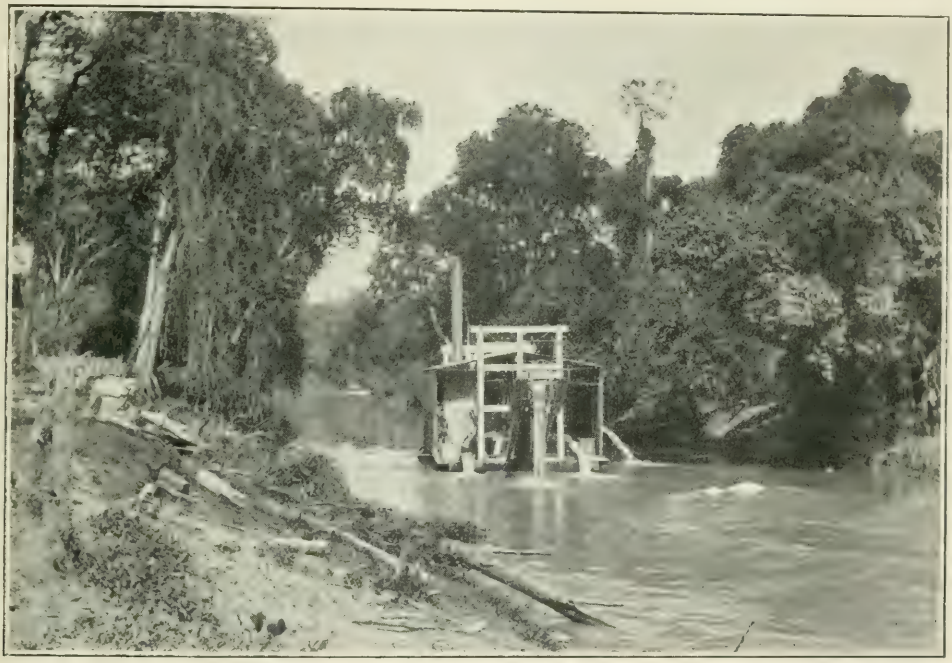
A good report concerning the Ancobra dredging enterprise is brought by Mr. S. J. Weis, recently appointed manager. He finds that the present dredges are poorly adapted for local conditions and that the ground has been worked without system, but that the gravel is rich. Part of the property is virgin and invites the application of up-to-date methods, while even the ground that has been partly turned over may contain enough gold to be worth re-working. A vigorous campaign of drilling is now in order, previous to erecting a new dredge suitable for West African conditions. Apparently in this case some time and gold have been wasted, but it is not too late to retrieve the position.

AUSTRALIA.—Our Melbourne correspondent sends an interesting account of the Tanami goldfield, with comments on the Chillagoe and Mount Elliott copper enterprises.

The directors of the Broken Hill Block 10 have decided to spend £20,000 in remodelling the lead-concentration plant, which, though doing excellent work, is not so modern as those at the North and South mines. The manager of the North mine, Mr. George Weir, was asked to advise in collaboration with the manager, Mr. V. F. Stanley Low, and he has made recommendations that should save an additional £20,000 per annum. It is only a few months since the company discarded the newly erected Elmore plant used for the treatment of the zinc tailing, and decided to ship the material to the De Bavay plant instead.

Mr. Weir's services appear to be much in demand; he is also advising Block 14 with regard to the design of a plant for treating the low-grade sulphide still in the mine.

The action brought by the Elmore companies in the New South Wales court against the Sulphide Corporation for damages on account of the use by the latter of the Minerals Separation process has been dismissed. Announcement is made that the Elmore companies are appealing to the Judicial Committee of the Privy Council in London, for final settlement of the dispute.



DREDGING ON THE ANCOBRA RIVER, WEST AFRICA.

INDIA.—The accident that occurred at the Champion Reef mine on July 25 draws attention once more to the 'air-blasts' that are comparatively common in the Kolar district, especially at this particular mine. Stoping was being done at the 22nd level north of Carmichael's shaft, a comparatively shallow part of the mine. A large number of natives were at work and the sudden disaster buried several and hurt others. Fifteen were killed outright and four more died in hospital. The staff of John Taylor & Sons and the Government inspectors, headed by Mr. W. F. Smeeth, have for years been making enquiries into these 'air-blasts,' and though some are eventually found to be ordinary falls, many others are undoubtedly to be attributed to the release of pressure from schist in a state of internal strain. How to prevent or predict such accidents is more than they have been able to ascertain. The most serious occurred three years ago at 1098 ft. during the sinking of the new circular shaft, a special report on the subject having been made and published by Mr. Smeeth at the time.

UNITED STATES.—We publish a letter from Juneau, Alaska, written by a particularly well informed correspondent and giving the latest news from that part of the world. Our San Francisco and New York correspondents refer to copper operations. We note also that the Calumet & Hecla mining company has issued, for the first time, a tabulated comparison

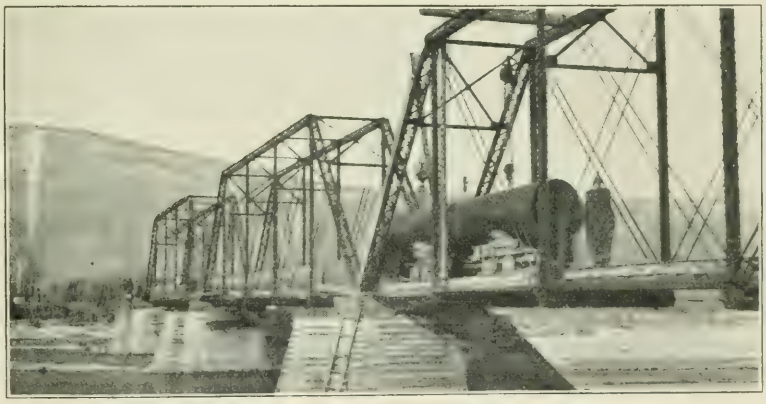
of results, from which it appears that in 1910 the mine yielded 72,059,545 lb. copper from 2,795,514 tons of ore. The yield was 25·77 lb. per ton or 1·28% copper. The total cost of this copper was 8·96 cents per pound and the price received was 13·20 c. per pound. The yield of copper was 31·22 lb. per ton of ore in 1908 and 28·18 lb. in 1909. Ten years ago it was 60 pounds.

In Colorado a systematic effort is being made to stimulate prospecting, the Denver Chamber of Commerce having raised a fund of $10,000 by popular subscription. This is the basis for a 'Grubstake & Development Company' capitalized for $2,000,000. Great efforts are being made at Leadville and at Silverton to beneficiate low-grade zinc ores. A revival in placer mining, especially in Summit county, has followed successful dredging near Breckenridge. Rich gravel is claimed also to have been found in Newlin gulch, in the valley of Cherry creek, where gold was first found in Colorado in 1852.

CANADA. — The fire at Porcupine, which raged fiercely for three days, did not depress shares in local mines as much as might have been expected. This was due to the prompt action of the stock-exchanges at Toronto and Montreal, which were closed from the 12th to the 17th of July. Selling at New York caused some declines, now mostly recovered. Hollinger fell at one time to $10·75, for it was natural that those mines nearest to the productive stage should be most injured by the disaster. Mere prospects have not much plant to lose. Cats proverbially have nine lives; wild-cats are even tougher. At Porcupine they were barely singed. Undoubtedly the biggest loss was at the Dome mine, where a first-rate mill, nearly completed, was destroyed. This mill would have enabled the Dome to make a noteworthy production, of great service to the reputation of the district. We are glad to learn that the Bewick-Moreing camps were saved. A relief committee is now hard at work; already 35 search parties have been sent out to aid disabled persons, the area swept by the fire covering a tract nearly 30 miles square. Both of the railway stations, at Kelso and Cochrane, were burnt, but this has not stopped the train service. It is stated, in London, that two new issues are impending, both of them to be launched by the Timmins syndicate. One is called the Dixon, with a capital of $5,000,000, and the other the Miller-Middleton, with a capital of $3,000,000. Both properties are near the Hollinger.

Announcement is made that the Consolidated Gold Fields, through its subsidiary American company, has acquired a large holding in the Yukon placer enterprise originated by Mr. A. N. C. Treadgold and financed in part by Messrs. H. C. Hoover and A. Chester Beatty. We made reference to this business in our April issue. The property comprises 10,000 acres of alluvial ground in the Klondike valley, near Dawson, and in the district rendered famous by the great rush of 1898, and later by the Guggenheim operations under the title of the Yukon Gold Company. In this connection it becomes interesting to note that the Yukon Gold Co. in 1910 produced gold to the value of $2,847,098. The annual report states that the 7 dredges handled 3,249,788 cubic yards during a season of 159 days, producing $2,150,723 or 66·18 cents per yard, at a total cost of 31·09c. per cu. yd. This includes thawing, which cost 14·6c. per cu. yd., and other preliminary outlay. The hydraulic mining and mechanical elevators moved 705,544 cu. yd. for a yield of $696,375 or 98·7c. per yd., at a cost of 25·69c. per cu. yd. These figures do not include the royalties paid. Apparently the mining profit was $1,655,471. On turning to the original prospectus, issued early in 1908, we find that the profit predicted for 1910 was $2,500,000. At the time when the Yukon Gold was floated, the cost of dredging was estimated by Messrs. O. B. Perry and A. C. Beatty at 30c., with a

profit of 39c. These figures compare well with the accomplishment today. At the same time and by the same engineers the cost of working the hill gravel was put at 10c., with a profit of 22c. per cu. yd. Owing to the use of mechanical elevators in the creek-bottom and the mixing of the results with those obtained from hydraulicking the bench-gravel, it is not possible to make a comparison with the original estimate, but the combined cost of 25·69c. and the combined yield of 98·7c. seem to justify the technical forecast, except as to the quantity of gravel exploited. If the Yukon Gold had been properly capitalized and if in its infancy it had not suffered from an attack of whooping cough due to a certain Thomas W. Lawson of Boston, it would today rank as a most creditable performance.



PIPE-LINE OF THE YUKON GOLD CO. CARRIED ON A BRIDGE ACROSS THE KLONDIKE RIVER.

The sale of the Le Roi mine to the Consolidated Mining & Smelting Company of Canada for $250,000 closes a disagreeable chapter in British mining enterprise. The smelter at Northport remains in the possession of the liquidator.

MEXICO.—Our correspondent sends interesting items concerning the oil companies. The revolution is having its effects on concessions, and on labour. The grant of blanket concessions may have helped individual operators but it has tended to hinder prospecting. The unrest among labourers is natural, for now that Diaz is gone they feel that they may assert themselves with impunity. Several strikes have ensued. They are being quieted.

On August 1 the managers of the three principal mines at El Oro telegraphed to say that operations were stopped by a riot of miners on strike, aided by prisoners released from the gaol. Foreign residents sent their womenfolk to Mexico City by train. Next day it was announced that the military were in control, the mills were still running, but that the mines were idle. Since then order has been completely restored and all the mines are again in full operation.

The Mexico Mines of El Oro issues the manager's annual report, from which it appears that the mine is in a healthy condition, the reserve having been increased 35,000 tons without diminution in grade. The gross output is $1,528,229 from 136,408 tons as against $1,392,336 from 136,372 tons last year.

Esperanza shareholders have been cheered by news of a discovery in a cross-cut extended westward on the lowest or 11th level of the mine. After passing through the San Rafael lode another new vein was cut, carrying five feet of ore assaying 26 dwt. gold and 4 oz. silver per ton. A drift has been started both ways and is in good ore. Going south

the boundary of the Ofir claim is near, but northward there is plenty of room—1500 ft.—for important developments. At Pachuca, the Santa Gertrudis mill is now running at nearly full capacity, 50 stamps dropping out of 60. Mine developments continue satisfactory.

It is noteworthy that A. Goerz & Co., a firm prominent in South African mining, has opened an office at Mexico City, placing Mr. Cyrus T. Pott in charge.

SIBERIA.—Washing of gold-bearing gravel is proceeding satisfactorily at the mines of the Lenskoie, the Russian company in which the Lena Goldfields hold a controlling interest. Up to July 20 the yield has been 255,615 oz. gold from 504,172 cubic yards of gravel. Last year at this time the production was 250,624 oz. from 427,378 yards. An interim dividend of 3s. per share has been declared, and it is expected that another of equal amount will follow the annual meeting in November.

At the Orsk Goldfields the Pokrovsky washing-plant has been winning gold at the rate of a pennyweight per cubic yard, a result that is encouraging, if it can be ascertained beyond doubt that this is a fair sample of the ground. Mr. C. H. Munro, the new manager, has started drilling and pit-sinking on a large scale, so that any doubt should soon be removed or confirmed.

The directors of the Troitzk Goldfields have followed the example set by the Orsk Goldfields in raising fresh capital by an issue of 104,993 priority shares, increasing the nominal capital to £625,000. It is estimated by this company's consulting engineers, Messrs. Hooper, Speak & Feilding, that a working profit of not less than £39,658 per annum is assured, provided their scheme of development and equipment is adopted.

VARIOUS.—The injury to mining done by Central American revolutions is suggested by the report of the Oroya Leonesa company, from which it appears that their mine in Nicaragua has suffered delay both in development and equipment, necessitating the provision of additional capital. The mine itself seems to promise well and now contains 94,400 tons of ore averaging 39·7s. per ton, besides lower-grade stuff.

The directors of the Maikop Spies company show commendable restraint in referring to the prospects of the Maikop oilfield; in their first annual report they state that development "has been delayed by the difficulties invariably met with in a remote and virgin country. . . . The geological conditions differ markedly from those of the other great Russian fields, volcanic influences having apparently produced great irregularities in the strata. . . . Meanwhile it has been proved by ourselves and other companies that large quantities of oil exist in certain sections." It is two years since British capital was attracted to the Kuban province, now famous as Maikop, and much money has been subscribed. Dividends are lacking as yet, but oil is being produced and marketed; as shown in the articles published by us, real progress is being made and active prospecting by drilling is under way. The dimensions of the productive area should be ascertained by the end of the current year.

The Oroville Dredging Co. has finally obtained the transfer, from the American company, of the Pato dredging concession in Colombia. A delay of two years in concluding the deal was caused by the insistence of the vendors, who take 25% of the shares in the new company, and demanded an agreement that no change of capitalization or other liability could be incurred without the consent of 90% of all the shareholders. Mr. H. S. Derby, representing the vendors, won his point, after much delay. Meanwhile $325,000 has been advanced by the Oroville company and a dredge is being completed, with the expectation of beginning to dig in January. Everything points to a successful enterprise.

The ground is rich and the operations are in the hands of experienced men from California. The Oroville has a good chance of being rejuvenated by this expansion into Colombia.

SILVER.—Miners in Mexico, for instance, may not be aware that the price of silver is affected by the Indian monsoon, yet it is a fact that the market is sensitive at this time to the news regarding the rainfall. As monsoon prospects in India are good, the price of silver has risen to $24\frac{1}{8}$ pence per ounce.

the producers throughout the world are at their maximum output, and there is little likelihood of any important new sources of supply. The Conventions that regulate the outputs and prices are in consequence assuming a firm attitude, and users exhibit nervousness as to the future. These conditions are the cause of the vitality shown by Broken Hill shares on the Stock Exchange to which we refer elsewhere.

Owners of properties containing complex

ROUND THE SAMOVAR. A SCENE IN SIBERIA.

TIN mines have continued to attract attention, especially in the Malay States. Results encourage speculation, especially at the Tronoh, which announces a profit of £53,500 for July. The output during that month was 635 tons of concentrate, valued at £72,000, with a working cost of £18,500. For the last three months the company has earned a profit of £143,100 on its nominal capital of £160,000. The rainy season, now impending, will curtail production.

LEAD AND ZINC.—Present conditions point to the approach of a period of high prices in lead and zinc. Trade throughout Great Britain and the Continent is excellent, and so the demand is increasing. On the other hand, all

or low-grade ores are naturally reviewing the altered position as it affects them. The controlling Conventions however have such a power for raising and lowering prices that financiers are not quite convinced of the desirability of embarking any large amount of money in these new ventures.

COPPER.—The statistics of the American Copper Producers Association indicate that in July the production decreased 12,386,000 lb. as compared with June, and that the stock of metal in hand at the end of the month had declined 19,695,000 lb. Thus the production is the smallest this year, excepting February, while the deliveries for export are the largest. Only the domestic deliveries are disappointing.

STATISTICS

Stocks of Copper in England and the Continent.
Reported by Henry R. Merton & Co.

	May 31. Tons	June 30 Tons	July 31 Tons
In England	57,557	55,579	53,807
In France	6,081	5,843	5,893
Afloat from Chile	2,200	1,500	2,075
Afloat from Australia	6,775	7,250	6,250
Total	72,613	70,172	68,025
In Rotterdam	7,250	7,200	7,550
In Hamburg (estimated)	10,500	10,100	10,400

American Copper Producers' Association.
In Tons of 2,240 lb.

	Production.	Deliveries			Stocks at end of month
		Domestic	Foreign	Total	
January 1911	51,650	18,785	23,753	42,538	63,591
February	49,030	22,553	20,139	42,692	69,929
March	58,273	29,500	26,375	55,875	72,325
April	52,716	23,396	27,736	51,132	73,909
May	56,679	28,814	27,669	56,483	74,105
June	55,605	27,525	31,902	59,427	70,283
July	50,075	25,438	33,429	58,867	61,491

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
July, 1910	610,664	28,050	638,714	2,713,083
August	623,129	26,140	649,269	2,757,919
September	621,311	25,588	646,899	2,747,853
October	627,445	25,702	653,147	2,774,390
November	617,905	24,686	642,591	2,774,390
December	616,668	24,327	640,995	2,722,775
Totals, 1910	7,228,588	305,532	7,534,120	32,002,912
January 1911	625,862	25,201	651,027	2,765,386
February	585,683	24,965	610,828	2,594,634
March	649,247	26,818	676,065	2,871,740
April	638,421	29,293	667,714	2,836,267
May	658,196	27,755	685,951	2,913,734
June	657,023	27,544	684,567	2,913,734
July	679,881	29,377	709,258	3,012,738

Cost and Profit on the Rand.

Month.	Tons	Yield per ton	Costs per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
January 1911	1,865,232	26 6	17 11	10 1	930,059
February	1,712,198	28 0	18 3	10 3	874,612
March	1,960,678	28 6	17 11	9 9	949,415
April	1,926,583	27 7	17 6	10 1	971,858
May	2,002,926	27 7	17 10	9 7	956,823
June	1,986,559	27 6	17 11	9 8	960,381
Totals and averages for 1909	20,543,759	28 11	17 1	11 6	11,794,376
Ditto 1910	21,432,541	28 6	17 7	10 6	11,216,105

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31	183,268	8,357	9,991	201,616
February 28	189,434	8,513	9,814	207,761
March 31	193,457	8,493	10,061	212,011
April 30	194,328	8,511	10,272	213,111
May 31	190,392	8,379	10,425	209,196
June 30	186,940	8,212	10,597	205,749
July 31	181,582	8,122	11,054	200,758

Gold Output of India.

Year 1909	Year 1910	July 1911	1911 to date
£2,083,901	£2,104,858	£179,558	£1,231,880

Production of Gold in Rhodesia.

Month.	1908	1909	1910	1911
	£	£	£	£
January	199,388	204,666	227,511	207,903
February	191,635	192,497	203,888	203,055
March	200,615	202,157	228,385	231,947
April	212,935	222,700	228,213	221,296
May	223,867	225,032	224,888	211,413
June	224,920	217,600	214,709	215,347
July	228,151	225,234	195,233	—
August	230,792	228,296	191,423	—
September	204,262	213,249	178,950	—
October	205,466	222,653	234,928	—
November	196,668	236,307	240,573	—
December	217,316	233,397	199,500	—
Totals	2,526,007	2,623,788	2,568,201	—

Production of Gold in West Africa.

Month.	1909		1910		1911	
	Oz.	Value	Oz.	Value	Oz.	Value
		£		£		£
January	22,817	91,112	17,357	70,699	15,903	66,107
February	21,403	86,210	16,976	68,469	15,179	63,081
March	23,186	93,556	17,627	71,954	16,387	67,673
April	21,491	88,071	16,363	67,069	17,237	70,880
May	25,104	100,056	16,590	68,355	24,427	96,409
June	17,340	70,561	17,194	70,988	22,555	92,174
July	17,331	70,523	15,564	58,551	—	—
August	17,766	71,614	13,921	57,713	—	—
September	18,125	72,963	11,497	47,746	—	—
October	15,957	65,813	13,341	55,046	—	—
November	17,882	73,824	14,021	57,658	—	—
December	17,570	71,332	15,042	61,737	—	—
	235,972	955,635	185,493	755,985	—	—

Production of Gold in Western Australia.

Month.	Export oz.	Mint oz.	Total oz.	Total value
				£
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
January 1911	17,463	102,035	119,498	507,592
February ,,	22,047	84,991	107,038	454,666
March ,,	12,296	93,267	105,563	448,426
April ,,	20,455	91,791	112,246	476,787
May ,,	22,076	88,952	111,028	471,615
June ,,	10,523	106,464	116,987	497,188
July ,,	15,334	97,387	112,721	478,805

Other Australasian Gold Production.

	1909	1910	July 1911	1911 to date
	£	£	£	£
Queensland	1,916,468	1,840,337	143,500*	783,810*
New South Wales	869,546	803,727	56,517	432,791
New Zealand	2,006,910	1,896,322	199,246	1,081,366
Victoria	2,897,340	2,422,700	190,894	1,224,600

* June figures only.

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
June 12, 1911	221¾	£26,403	£119 1 5
June 26, ,,	269⅛	£31,399	£116 10 2
July 10, ,,	213¼	£25,019	£117 6 5
July 26, ,,	254¾	£28,484	£111 16 3

Exports of Tin and Ore from Straits and Bolivia.
Reported by A. Strauss & Co.

	June, 1911 tons	July 1911 tons	1911 to date tons
Metal from Straits to Europe and America	5,060	4555	30,117
Metallic Content from Bolivia to Europe	2,056	2332	13,005

EDITORIAL

AT THE TIME of writing, London, Liverpool, and other centres of industry are on the verge of paralysis by reason of a widespread strike, started by workers at the docks. How far-reaching its effects may be is suggested by the fact that milling at the Mountain Queen mine in Western Australia will be postponed at least three months by reason of the inability of the mail steamers to take the heavy machinery required to complete the plant.

IN REFERENCE to the note in our last issue concerning the unpleasant incident at the Kyshtim, we are informed that the Syssert estate was at one time under option to the Anglo-Siberian Co., and that this option passed later, on different terms, to the Russian Mining Corporation. This explains the little feeling that may have been at the bottom of the misunderstanding. The visiting engineers were in the employ of the Russian Mining Corporation, while the resident engineers were acting under orders from a company that is a subsidiary of the Anglo-Siberian company. It was not a simple case of withholding technical information.

EARLY in August our friend the *Mining and Scientific Press* moved from 667 Howard street to new quarters at 420 Market street, San Francisco. The offices on Howard Street were in a temporary structure erected after the earthquake-fire and represented a makeshift during the period of reorganization. The new quarters are close to the spot where the *Press* was housed before the disaster of April 18, 1906, and on the main thoroughfare of San Francisco. The oldest mining paper in America has been tried in the fire and found not wanting; it was shaken by the earthquake and stood firm; it has shared the manifold life and development of the Pacific Coast region, and while it has had to move more than once, it has always moved on and moved upward. We shake hands with our friends on the other side of the world and wish them continued success.

GEOLOGICAL THEORIES are rarely of such economic importance as those that correlate the various systems of gold-bearing banket in the Transvaal. Our readers will have heard that Mr. W. E. Bleloch has undertaken to combat accepted views and has issued a treatise, with a map, to expound his own notions on the subject. These are worthy of respectful consideration; therefore we take pleasure in publishing, elsewhere in this issue, a review by Mr. S. J. Truscott, who is well qualified to express the orthodox opinion on this scientific problem.

AMONG DEEP MINES the Morro Velho of the St. John del Rey company, in Brazil, is interesting, not least because it pays its shareholders a regular dividend. The company was organized in 1830 and has undergone reconstruction twice, in 1887 and 1888. In a recent issue we gave a cross-section of the mine showing the workings to have reached a vertical depth of 4926 feet, equivalent to 7000 ft. on the dip of the lode. At that depth ventilation is well maintained, but the health of the miners suffers owing to their being subjected to a great variation of temperature, from 95° F underground to 70° at surface. The rock is dry and the men suffer much from the inhalation of dust. Apart from its depth, however, the Morro Velho is remarkable, as representing the life-work of Mr. George Chalmers, who has overcome disasters

and difficulties enough to dismay any but the most enterprising and courageous of men.

WE NOTE with pleasure that the University of Minnesota gives its freshmen engineers a two-hour course in English and that this is joined to a two-hour course in practical composition. The two authors chiefly studied are Arnold and Huxley. 'Sweetness and Light' followed by 'A Piece of Chalk' afford models of thought and expression well fitted to stimulate the mind of a budding engineer. We send our compliments to the faculty of the University of Minnesota and look forward to the time when our columns will be enriched by observant young men trained in the use of their language, which is also ours.

THE STORY of the original purchase of the Nipissing from the prospector who found it, seems worth telling, as obtained from one closely associated with the transaction. In 1901 the son of Mr. J. P. Earle happened to be camping and fishing on Lake Temiskaming when some prospectors showed him specimens of very rich silver ore. He sent them to his father in New York and they were assayed, proving of phenomenal richness. Mr. Earle had just made a good turn and had some spare cash. Taking a certified cheque with him he started at once for Ontario to see the find. He estimated that if the pocket of ore in the prospect hole continued ten feet deeper he would get a return of the purchase price asked. He accepted, and then and there filled out the certified cheque for the amount. His first shipment a few weeks later netted $285,000 or considerably in excess of the sum paid. Thus again we have an illustration that truth is stranger than fiction, for some of the mineral supposed to be silver was probably smaltite and the calculation of ten feet of persistence might just as well have been based on a hundred feet. He betted on a contingency that happened to be more than fulfilled. Thousands have taken similar chances but so unsuccessfully that the facts have not been deemed worthy of record. The Nipissing has already paid $6,500,000 in actual dividends, nearly thirty times the amount paid for it.

MUCH TIME is wasted in the city of London by reason of errors made by telephone operators. It is not too much to say that the telephone system of the metropolis is not equal to that of a second-rate American town. However, when the transfer of the system has been completed to its new owners, we may expect an improvement. Blessed are they that expect nothing, for they shall not be disappointed. Meanwhile we would suggest some uniformity in the etiquette of telephoning. When Smith wants Brown, Smith's clerk rings to Brown's clerk, and the latter tells him to put Smith on the line, whereupon Smith holds the telephone awaiting Brown's pleasure. Brown may be busy and the call is delayed or it proves abortive. It appears clear that the man who initiates the call must be at the telephone or close to it, for it would be impertinent for him to 'call up' a friend if he himself is engaged or otherwise unprepared to speak promptly. On the other hand it is always uncertain whether the man called is free to talk. Therefore it should be unnecessary to require the caller to hold the telephone until he is informed whether his friend is at liberty. Obviously a man should not ask another to come to the telephone unless he himself is ready to speak. At present time is squandered at both ends; it seems possible to save it by a little mutual consideration.

REFERRING to the trial of the Giesecke mill at Johannesburg, we are informed that after the inventor, Mr. Karl Giesecke, left, on his return to Brunswick, the wear and tear increased enormously, while the capacity of the mill decreased. From an

average of 17 tons per hour the crushing declined to 16 tons per hour by day and 5½ tons per hour by night. These figures point clearly to incompetent supervision and tend to emphasize the fact that in the use of machines of this kind the character of the feeding is decisive. The wear of balls and plates was excessive after the first three weeks during which the inventor superintended the test, and an effort is now being made to obtain balls that are tough not only as regards an outer shell but throughout, that is, not merely case-hardened; otherwise the wear becomes rapid when the comparatively soft interior is exposed to attrition. However, the wear on the balls in the Giesecke mill cannot be more severe than in an ordinary ball-mill, which does not give excessive trouble on this score. The large balls are usually made of forged steel, and manganese steel has been successfully used in making the smaller ones. It is obvious that the Giesecke trial at Johannesburg will draw increased attention to this type of pulverizer.

INTEREST in tin mining within the Federated Malay States has been stimulated by the high price of tin and the success of the Tronoh, Gopeng, and other British undertakings. Therefore the formation of a smelting company is quite in order. The one in question, called the Eastern Smelting Company, has been formed to acquire from the Penang Company the smelting business purchased three years ago from Mr. Lu Chin Ho, one of the many enterprising Chinamen who have taken a prominent part in the Malay tin industry. The directors of the new company are only three in number but they should constitute an excellent board, including as they do the late British Resident of Perak, a partner in Vivian, Younger & Bond, and a partner in Lake & Currie. Thus the executive includes an experienced administrator, a metal broker, and a mining engineer. We hope, and expect, that this smelting enterprise will be successful. It serves to remind us of a curious episode in the history of tin mining in the Far East. In 1903 a smelter was erected at Bayonne, New Jersey, with the avowed purpose of treating tin concentrate from the Straits Settlements. The American syndicate that organized the enterprise anticipated obtaining a low ocean freight by the Standard Oil steamers returning from the petroleum markets of the Far East. It was also expected that from the tin thus produced it would be convenient to make tin-plate for the oil-cans; so that the oil industry and the tin industry would prove mutually helpful. Unfortunately in June of that year, just when the Bayonne smelter was ready to start work, the Government of the Federated Malay States imposed a duty of $30 per picul on all tin ore exported, thus killing the American enterprise. This export duty should now be a source of comfort to the Eastern Smelting Company.

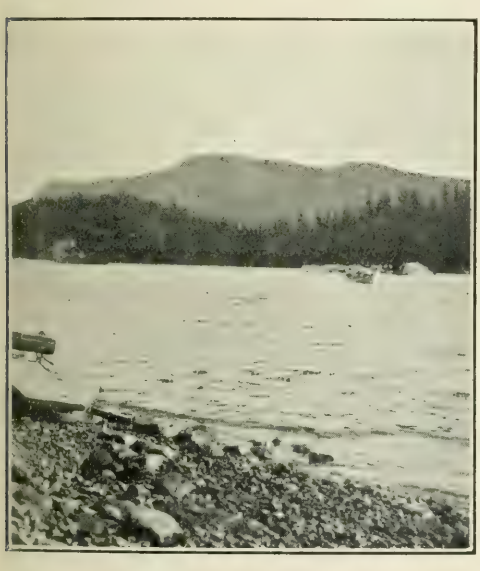
AMONG publications furnishing useful information on mining and metallurgical progress is *Mines and Methods*, a monthly journal published at Salt Lake City, Utah. It is now nearly two years old and is thus our contemporary in the literal as well as the literary sense. During these two years this Western American periodical has provided a considerable quantity of technical information, which would have inspired greater confidence if obviously it had not been used chiefly as a stone to hurl at the head of the Utah Copper Company. Even a casual glance at the pages of *Mines and Methods* shows that its chief purpose is to attack the personnel of the management controlling the biggest copper enterprise in Utah. This vendetta is inspired by Colonel E. A. Wall, whose Improved Ore Jigger also furnishes a subject for the principal page of advertisement. Into Colonel Wall's quarrel with the Utah Copper we shall not probe, for we have no clear notion of its underlying cause, any more than that which

prompted the violence of a verbal attack, duly recorded in *Mines and Methods*, made by the editor, Mr. Claude T. Rice, against Mr. D. C. Jackling, the general manager of the supposedly objectionable company. In the interests of technical journalism, however, we do not hesitate to say that technology ought not to be used as a cloak for a private quarrel. Notwithstanding the obvious merit of many of Mr. Rice's writings they are unreliable for the simple reason that so many of them are prepared not so much to give interesting technical data as to serve as a catapult against the Colonel's enemy; in short, they are not trustworthy. As now conducted *Mines and Methods* ranks with a broker's circular; of such there are plenty.

IN THIS ISSUE we publish an interesting and informing article on mining in Rhodesia by Mr. F. P. Mennell. This contribution is the outcome of a friendly controversy, Mr. Mennell having taken exception to some of the opinions expressed by us on mining affairs in a part of Africa with which he is familiar. He could not have paid this magazine a more agreeable compliment than first to criticize and then to contribute. Purely destructive criticism is rarely useful, although sometimes amusing, but the correcting of supposed errors by the submission of authentic information is constructive in its highest sense. The opinions expressed by us were, we believe, not so far from the truth as Mr. Mennell claims, but their value has been enhanced by his own supplementary statements. Every subject has several facets; we are glad when our friends draw attention to such aspects as, for lack of space or information, we may appear to neglect. It cannot be said too frequently that we welcome intelligent criticism rather than idle compliment. No man and no group of men can envisage the whole of a subject so broad as mining in its worldwide aspect. A polite Amen leaves us as we were; a sincere protest or an interested correction helps us onward in our purpose, which is to give information useful to those engaged in mining. This magazine is tied by no strings save the cord of sympathy with all those that go down the mine in skips. We welcome frank discussion at all times and we take this opportunity of thanking Mr. Mennell for so obvious a comprehension of the spirit that animates our work.

OUR READERS will have seen the newspaper accounts of the wreck of the *Spokane* on the coast of British Columbia on June 29. Only three passengers lost their lives, but among these was the wife of Mr. Gardner Williams, who, with her husband, was on the way to Treadwell, Alaska. They were accompanied by Mr. and Mrs. W. W. Mein, the latter being a daughter of Mr. and Mrs. Williams. When the vessel struck, an inrush of water swept Mrs. Williams down the gangway, so that she was drowned. Another mining engineer well known to the profession was on board in the person of Mr. Philip Argall, who was accompanied by two of his daughters. The father saw them safely in a lifeboat, and then helped the other women to get off. As the last boat got clear the ship listed to starboard and sank, the lights were extinguished, and the scene was blotted with inky darkness. The wreck was only 300 yards from the shore, but no one was aware of the fact and no one had the sense to light the lamps in the life-boats. Mr. Argall climbed into the rigging as the steamer settled in the shallow water above a sand spit and when the camp-fires began to twinkle on the shore he swam toward them, being picked up by a returning lifeboat. Thus he escaped and both of the daughters, one of whom had her knee dislocated. The Pacific Coast Steamship Co., the owners of the *Spokane*, returned the passage money but refused compensation for baggage or other loss. The

ship struck a rock in the Seymour Narrows at 11.15 p.m. of June 29 but it was possible to steer her into the quiet waters of Plumpers Bay before she sank. On board there were 150 passengers and a crew of 80. The night was dark, the passengers remained quiet and self-possessed, the crew were largely under the influence of drink and made a sorry exhibition. Unfortunately the steamers plying along the coast of British Columbia and Alaska represent an inferior type, most of the capable and energetic avoiding the poor pay and restricted quarters of a small vessel.



The wreck of the steamer Spokane in Plumpers Bay. Two lifeboats in attendance, gathering floating baggage.

The steamers themselves, with a few exceptions, are quite unworthy of the regions to which they carry mails and supplies. This is all the more regrettable as the voyage from San Francisco or Seattle to Juneau or Valdez is one of the most picturesque and interesting in the world.

Finches and Finance.

It is only about six months since we warned the public against the litter of wild-cats let loose from Bullfinch in Western Australia, yet even this short interval has been enough to give regrettable confirmation to the anticipations then expressed. The abandonment or liquidation of several of the companies then formed has been announced recently and others are apparently moribund. The Bullfinch East company, introduced on November 9, 1910, with a capital of £120,000, without an engineer's report, but with shares at a premium, is now to be liquidated. The consulting engineer, engaged after the flotation, not before, advises that "the prospects do not warrant further expenditure" at this alleged gold mine. The Bull Ant Proprietary was issued on November 23, 1910, "with a capital of £200,000 and a few general statements of an unconvincing character." We quote from *The Mining Magazine* of December 1910. In this case a circular has been sent to the shareholders stating that "the developments upon the property so far do not justify further expenditure upon it" and offering to exchange two shares of Bull Ant for one share of Bullfinch Proprietary. The shares of the latter, the parent of the pups that made such a splash not long ago, are now quoted at about 15s. as against the £3½ to which they were hoisted last December on the basis of information that may indeed have been perfectly honest but was also palpably prejudiced. Meanwhile the Bullfinch Proprietary has proved to be what we feared, a patch of rich ore in jasperoid ironstone, of a character similar in non-persistence to many others found in Western Australia. In November 1910 the Premier of Western Australia stated publicly that "even Kalgoorlie and the Golden Mile sink into insignificance when one listens to reports regarding the [Bullfinch] property, which bids fair to eclipse anything discovered in the history of the State." No punishment can be greater to an irresponsible official than to quote his own fatuous remarks. The episode should serve again to warn the public against opinions concerning the value of mines expressed by

persons without the training and experience required in such matters, and to emphasize the necessity for obtaining proper advice before subscribing capital for hazardous ventures.

Impoverishment in Depth.

The paper recently submitted by Mr. C. O. Schmitt to the two technical societies in London and Johannesburg appears to have excited much attention. We have refrained hitherto from augmenting the volume of discussion because the main point at issue did not seem to us to call for special comment. However, some of the statements provoked in rebuttal of Mr. Schmitt's rather confident assertions cannot be passed without remark. Indeed, we congratulate Mr. Schmitt on having stimulated investigation of a problem vital to mining, namely, the persistence of ore in depth. Next to the submission of a new theory or a fresh fact, nothing can be more useful than an occasional discharge of argument, the electrical effect of which goes far toward clearing the intellectual air in which technology lives. The gentleman in South Africa assumed that the yield of the ore broken on the Rand had decreased in its content of gold as the depth of mining had increased. This we supposed to be an acknowledged fact. But Mr. Schmitt, not content with assuming a generalization, proceeded to tabulate the yield of the mines at successive horizons, asserting that the average yield of crude ore was 34s. per ton at 1000 ft. and would diminish to 17s. at a mile below the present surface. For each thousand feet he predicated a definite average yield, and with it a regular diminution in richness. Not satisfied with this rash venture, he argued backward by stating that as the average yield per ton milled was now 28 shillings, therefore the average depth from which the ore is hoisted must be 2400 feet. Here he fell foul of his critics and left himself vulnerable to attack from several directions. As is well known the depth of the mines operated at Johannesburg differs widely, from a few hundred feet in the outcrop mines to a maximum of nearly 5000 feet in the deepest. Thus the Roodepoort United at 350 feet vertical can be compared with the Cinderella Consolidated where ore is being stoped at 4500 feet. The ore now being treated comes not only from mines of various depth but comes from different levels in the same mines, so that nothing but detailed and precise information concerning the source of the ore in each mine would furnish an exact basis for a categorical statement concerning the average depth at which the ore of the Rand is being stoped. Such information is not available; it was not available to Mr. Schmitt, nor to his critics. Some of the latter, as engineers to controlling 'houses,' can obtain the data required at their own groups of mines, but they have no ready access to the records of the rival houses. We note, however, that Mr. H. F. Marriott, consulting engineer to the Rand Mines and Central Mining group, asserts "on the most complete evidence it is possible to secure," namely, "that of the assay-values of samples of actual reef-widths taken throughout all the mines," of the group controlled by his house, that there is "no substantial evidence today . . . to prove a general deterioration" in the richness of the ore. This assertion is worth a lot of argument, coming from such an authority. Mr. Marriott will perform a service to the science of geology, to the industry of mining, and to the share market, if he will publish the evidence required to substantiate what he has said. In geology we have reason to believe that the conditions favouring the solution of gold are increasingly prevalent as depth is gained, while on the contrary the conditions compelling precipitation are predominant in the immediate approach to the surface of the earth. In mining we have the irrefragable testimony of world-wide experience that man has never yet failed to go deeper than

the ore rich enough for him to exploit and that all mines become eventually exhausted in depth. In the share market the idea prevails that these generalizations from science and experience are applicable to the Rand, although somewhat modified there by the unusual character of the banket deposit. We repeat, therefore, that as Mr. Marriott is in possession of the evidence, he can perform a signal service and further enhance his reputation by giving a complete statement of the case. At the very time when he was controverting Mr. Schmitt, a comprehensive lecture on the gold-mining industry of the Rand was being delivered by Mr. F. H. Hatch before the Institution of Civil Engineers. That gentleman, an acknowledged authority on Rand geology, stated in his lecture that he was " inclined to the view that a gradual impoverishment with depth does exist. It would be quite possible from existing records and assay-plans to settle this really vital question."

Our own view of the matter, which may be taken as that of many others who lack the detailed information accessible to consulting engineers connected with groups of Rand mines, but who have a general knowledge of the development of the Main Reef series, and a wide acquaintance with the history of gold mining in other regions, is that the richest ore was at the outcrop and for a couple of hundred feet down, within the zone of secondary enrichment due to vadose waters. Below this shallow horizon the ore showed no sudden impoverishment but exhibited variations according to structural conditions, as affected in part by dikes and other intrusions of igneous rock. As depth was gained an occasional area of impoverishment cut into the stoping ground of this or that mine, while in rarer cases barren territory was succeeded by profitable ground, so that the evidence did not all point one way. With additional depth the areas of impoverishment began to eat into the stoping ground to a greater degree, compelling some mines to close-down and others to consolidate with their more fortunate neighbours. Broadly speaking, we believe—in default of definite proof to the contrary—that the amount of 10 dwt. ore is less at 2000 feet than at 1000 feet, and still less at 3000 feet. Of course, the yield of the ore in the mill is no criterion. In the early days only the richest stuff was worked; as the scope of operations was enlarged, and big mills were built, the poorer ore became available, for the working cost had been diminished. This caused a rapid increase in tonnage and gross output of gold, with a compensating decrease in the yield per ton. When the tendency to lower the cost without regard to ultimate profit had been carried too far, a swing in an opposite direction ensued, and an effort was made to increase the profit by avoiding ore that was below the economic limit, that is, by refraining from the vicious practice of augmenting tonnage and getting a fictitiously low cost by mixing ore below grade with that which was well above grade. Hence all the statistical records must be read with an eye to these changes of policy. Again, it is obvious that as the cost diminished, from 33 shillings per ton in 1895, to 24s. in 1905, and to 17s. in 1911, the ore discarded in the upper levels of the deepening mines became a source of profit and was extracted, together with that of the lower workings. Some of this ore in the shallower parts of a mine might average poorer than that taken from the deeper stopes and yet would leave a good margin for dividends. Moreover, whereas in the early days only the South Reef and Main Reef leader might be stoped, the bigger Main Reef being unprofitable, yet as the mining industry became highly organized the cost of working was lowered to such a degree that the Main Reef became a source of profit, and is now stoped. These are among the causes explaining the difficulty of a direct comparison, except by those in a position to dissect the records. That the Robinson Deep has stoping

areas fully as good as the lower workings of the shallower Robinson, Ferreira, and Wemmer mines may indeed be true ; and the Crown Deep may have stretches of ground better than its neighbour on the outcrop, and so forth ; but how many instances to the contrary could be cited ? We forbear. Is it not written in the chronicles of liquidation, consolidation, and re-construction ? A mine may sometimes be started in unprofitable ore but it is rarely shut-down when in profitable ore. The whole problem is too serious for rhodomontade. Mr. Schmitt may have erred by proffering generalizations that he could not prove, but his most effective and most courteous critic is also rash when he talks about the "comparatively shallow depth of 5000 feet." How many mines on the Rand are going to be worked profitably below a mile in depth ?

Results on the Rand.

Any analysis of the results achieved during the first half of 1911 by the mining companies on the Rand shows one salient feature : a general tendency to increase the operating cost. This is due in part to the inadequacy of the labour supply and in part to an effort to restrict the output to profitable ore. Four of the seven mines of the Gold Fields group were particularly handicapped by the lack of labour, that is, the quota of natives required for the continually expanding scheme of operations. The Jupiter, which is the deepest mine of this group, has an increased yield of 4s. per ton, but the cost rose by 6s. 3d., so that the profit is 2s. 3d. less than in the corresponding six months of 1910. Despite the general increase of tonnage the aggregate profit of this group is lower. The Neumann group did a little better, especially the Wolhuter, which, with a larger plant, has produced more ore at a slightly smaller expense per ton ; yet three out of the five mines under this control exhibit an increased cost. The Goerz group with four companies shows a distinct betterment at the Lancaster West and Geduld Proprietary. The two big Robinson consolidations, the Langlaagte Estate and the Randfontein Central, both show a larger production, with a diminished profit in one case and a notable increase in the other. The Albu group suffered from re-organization at the Meyer & Charlton, where the output is one half what it was for the same period last year. Increased production is recorded at the six other mines under this control, with a bigger aggregate profit in the case of three companies. The Roodepoort United shows notable expansion, owing to additional milling plant. The Barnato mines, also seven in number, exhibit gains in every instance save one, the Witwatersrand, in which the grade of the ore has fallen without a compensating decrease in expenditure. The two Farrar properties have had bad luck. At the East Rand Proprietary two serious accidents crippled operations for a time, while at the New Kleinfontein the cost has risen in excess of the better yield. The 16 mines controlled by the Rand Mines and Central Mining group, formerly identified with Wernher, Beit & Co., and H. Eckstein & Co., exhibit an increase of aggregate profits, due chiefly to the yield of the City Deep and Bantjes mines. One half, that is 8, of the companies under this control show a higher profit per ton, yet 10 companies show a bigger rate of expense. Here we begin to see the result of the new policy, namely, the exclusion of ore that is below the economic limit. The Village Main Reef is the leader in this departure, decreasing its tonnage in the six months from 253,000 to 239,850, increasing the total expense from £413,651 to £441,234, and making a profit of £231,979 instead of £217,630. The average per ton for yield, cost, and profit was 36s. 10d., 17s. 5d., and 19s. 5d. respectively for this half-year as compared with 32s. 8d., 15s. 6d., and 17s. 2d. for the corresponding period last year. Apparently none of the other companies, unless it be the New Modderfontein, has adopted the

new policy so thoroughly and it remains to be seen whether it will commend itself to the point of imitation by the other groups. It is pleasing to note that the big consolidation of the Crown Mines, forming the most productive gold mining property in the world, is doing better than heretofore. During the six months the output of gold was worth £1,358,796, this being the yield from 759,100 tons. The profit was £615,990. Even these big figures are likely to be augmented by the starting of an additional mill, that of the Crown Reef, whereby the output should be fully 30% greater than it was at the time of the consolidation two years ago.

The Porcupine Fire.

To those who read newspaper accounts of catastrophic events the reality of sorrow and suffering is hardly felt. This is fortunate, for the whispering wire of the telegraph transmits the intelligence of disaster so easily from every quarter of the globe that life would be wrapped in horror if our sensitiveness had not been dulled by iteration. It needs therefore a personal touch to awaken sympathy with disaster in a distant region. Such a touch we regret to say was not wanting in the case of the conflagration at Porcupine, for among the lives lost were several mining men known to us, notably Leo H. Sulman, a young engineer of much promise and the worthy son of a distinguished father. Indeed the forest fires that raged among the mining camps of Northern Ontario in the middle of July must have kindled the keen sympathy of many who read this Magazine. Most of those engaged in mining know something about such devastating occurrences, for the bush fire of Australia, the burning veld of Africa, and the forest aflame in America have often taken toll of men, women, and children, not to mention the loss in livestock, machinery, and other forms of property. Apparently the disaster that gave a lurid fame to the gold mines of Porcupine was like other natural visitations of this kind. A wide tract of primeval vegetation dried to tinder under the cloudless sky of an inland plateau is invaded by prospectors and other pioneers in search of metallic wealth. An abandoned camp-fire, a discarded match, or the hot ash of a soothing pipe suffice to ignite the dry grass and awaken a demon of destruction amid the resinous pinewoods. An incendiary origin to such occurrences need not be imputed; it has been said that the destruction of the pegs or other monuments that mark a mining claim may be desired in some cases involved in litigation, but this sinister suggestion may be dismissed, especially in Canada, where the system of surveying is so simple and thorough as to facilitate the permanent recording of titles. On the other hand, it is a fact that miners are not sorry to see the ground cleared by fire, because this tends to make prospecting easier. In the Rocky Mountains it is believed that all forest fires are not accidental, and that in many cases they have been allowed to spread by men who could have extinguished them if so minded. Northern Ontario is covered with a mossy undergrowth that obscures the rock surface, and the new districts in which gold is being sought were first penetrated with difficulty on account of the widespread forests of birch and spruce. To the prospector the veil that Nature throws over her treasures is only a hindrance to be removed, laboriously by the axe or rapidly by the flame. Thus the fire that destroys a great natural resource is to him not an unmitigated evil, for in the early stages of mining not much timber is usually required. This point of view does not involve deliberate incendiarism, especially where human habitations may be endangered, but it does, we believe, explain the tardy efforts made to extinguish a bush fire before it becomes extensive. In the present instance several local fires appear to have spread until a whole region was in a state of conflagration. It will be remembered

that in June the Hollinger and other neighbouring mines suffered from this cause and in the early part of July the Dome Extension. For many weeks a succession of fires in various localities had become a feature of the long summer days. The culminating disaster involved a stretch of country nearly 250 miles long, from North Bay to Cochrane, stretching west of the Temiskaming & Northern Ontario railway, which connects the Canadian Pacific and Grand Trunk Pacific lines. A gale fanned the flames into fierce destructiveness. The town of Cochrane was one of the first to be destroyed; then followed Elk City, Miller Lake, Gowganda, and other settlements brought into prominence by the recent development of this portion of Canada. Finally, the fire reached the more populous locality in the vicinity of Porcupine Lake, where a mining boom was in progress. The clouds of smoke had been seen, but the warning was unheeded by men busily at work and grown familiar with bush-fires. Soon, however, the burning area was 30 miles long, the sun was eclipsed by smoke, and the swiftly advancing flames had reached the township of Tisdale, attacking the Standard and Imperial mines. The danger became obvious at South Porcupine. Whistles were blown by the mine-engines and everyone prepared for flight. The flames continued to gain, consuming the new buildings and plant of the Dome mine, and then the Eldorado, Preston - East Dome, West Dome, and North Dome. Finally the town itself was doomed and the fire swept around the lake, destroying several settlements. The inhabitants rushed for safety to the lake, embarking in boats of every description. Many simply stood in the cold water, some of them succumbing to the combined effect of heat and cold, of water and fire. One of the worst horrors was enacted at the West Dome mine, where Robert Weiss, the superintendent, not realizing the true position, led his men into the timbered shaft, there to be suffocated. Probably 100 lives were lost, but an exact count will never be made, for among the victims are included many small parties of prospectors isolated in the bush, and unknown, save for the charred bones that will be found in years to come when the tender green of a new growth has mantled the black trail of a great horror.

Coast Erosion.

Those who spend their holidays by the seashore in the long summer days are not likely to read Blue-books, more especially the one recently issued by the Royal Commission "appointed to inquire into and to report on certain questions affecting coast erosion," but even the least observant among them will not fail to note the traces of those natural changes that turn sea into dry ground and the habitable land into a watery waste. On the coast of Kent and Sussex, and generally along our southern shores, they will see how the tides are eating into our tight little island, undermining the chalk cliffs and whitening the waves with the spoil of the land. On the Suffolk coast, they will hear stories of forests submerged by the advancing tide, of villages over which the white horses now race joyously, and even of a sunken church from which in days of calm a muffled bell still calls to prayer. Such stories are not all fanciful. On the coast of Yorkshire, between Flamborough Head and Spurn Point not less than 115 square miles of land has been lost, and 12 villages are known to have been washed away, since the Roman invasion. At the present time the sea is encroaching on the coast of Holderness at the rate of 3 yards per annum. This is the maximum recorded in England. It is enough to provoke intelligent curiosity.

The relative position of ocean and land is not fixed, because the surface of the earth is undergoing slow oscillatory movement whereby the sea advances in some localities and retreats in others. Nature knows no stagnation;

life is synonymous with unrest; change is everywhere manifest; throughout nature the geologist sees "the traces of a past evolution and the germs of an eventual decay." The south and east coasts of England exhibit signs of an encroachment by the sea, due to a relatively slow sinking of that part of the island. About 4000 years ago the coast of Sussex was fringed by a belt of low ground extending to what is now the 10-fathom line. Behind this coastal plain was a more ancient line of cliff obscured by grassy slopes. Since then the rise of the sea-level has submerged the coastal plain and brought the higher land within the reach of the waves. These wash the chalk and loosen the flint pebbles of the cliffs, carrying the first out to sea on the receding tide and depositing the second as beaches of shingle and dunes of sand. In some places, as at Beachy Head, the wind and rain help to intensify the erosion due to the waves of the Channel and long before the water laps the cliff it has been reduced to a condition of decay. Yet from its ruins is made a defence. The shingle and sand eventually become a means of protection, the prevailing winds and currents moving them until they are arrested by headlands or river-mouths, or by such artificial barriers as groynes and piers. There they accumulate so as to constitute an effective obstacle to the further attacks of the sea and in many cases continue to increase in area so as to form alluvial land useful for pasture, delightful for golf, and even capable of cultivation. Thus we see how the loss of land is compensated. The Commission ascertained that within a period of 35 years "about 6630 acres have been lost to the United Kingdom, while 48,000 acres have been gained." The net loss is small but it is impressive, being marked by an occasional landslip or the collapse of a cliff so striking as to seem catastrophic. On the other hand the gain is scarcely noticed, for it exemplifies those geological forces that are cumulatively great. The result, however, is obvious, for example, along the west coast of North Wales, where, as at Harlech and Aberdovey, a sandy foreshore now stretches between Cardigan Bay and the former line of slate cliffs, while not far away at Borth, Barmouth, and Criccieth the encroachment of the sea is being retarded by the construction of groynes and walls. Balancing loss and gain, the Commission concludes that "from a national point of view the extent of the erosion need not be considered alarming." By the construction of simple defences, by avoiding dredging below the low-water mark, by discrimination in the removal of material on the sea margin, and by other precautions, even the present rate of loss may be lessened.

The character of the rock composing our island bulwarks is an important factor in withstanding attack from the sea. On our southern and eastern shores the soft deposits of chalk and clay, sandstone and limestone, offer but faint resistance, while on the western coasts of Scotland, Wales, and Cornwall the geologically ancient crystalline rocks, such as granite and gneiss, hard slate and harder diorite, turn a bold front to the invader. Yet even there they may have to surrender their substance continually to the onset of the unwearied sea. "Water would wear a stone" says a homely proverb; and when tons of water are hurled by the gale against the Cornish cliffs even they bow before the compelling force of old Ocean and yield their grudging tribute. Yet out of weakness are they made strong, for the shattered rock makes a barrier and the broken stone a barricade to the encroaching tide, delaying, but not stopping the sure advance. To prevent that a change of level is required, such changes as are observable in many portions of the earth's exterior and are recorded in the rocks. Raised beaches tell the tale no less than the marine shells buried in the sediment that now constitutes the mountain peak. The ancients knew something of this. They loved to speak of the Earth as a sentient being, passing through changes typified in their

own lives. Geology has but heightened the poetry of natural evolution.

"There rolls the deep where grew the tree.
O Earth, what changes hast thou seen!
There where the long street roars, hath been
The stillness of the central sea."

Those of us, and there are many, who abate the strenuous effort of the City to take a brief holiday in the waning summer days, traversing the turf-clad fore-shore in pursuit of the "wee bit guttie ball," may remind ourselves as we surmount a sand dune in search of that recalcitrant pillule that

"Where argosies have wooed the breeze,
The simple sheep are feeding now;
And near and far across the bar
The ploughman whistles at the plough;
Where once the long waves washed the shore
Larks from their lowly lodgings soar."

Bendigo.

The report lately issued by the Eaglehawk Consolidated serves to remind us how little British capital has participated in the successful mining that has made Bendigo famous, for Eaglehawk is adjacent to the district formerly known as Sandhurst and long celebrated as the locality where the deepest gold mining had been done. Such mines as have come under British control have proved disappointing, because they were among the least productive and were acquired on terms unlikely to give satisfactory results. The mines that have proved so remunerative to local owners have been worked on a system roughly analogous to the cost-book system formerly in vogue in Cornwall. When the mine was in rich ore the profit was distributed in dividends, and when it became impoverished the funds for further development were raised by calls. When the owners of shares were unable to contribute fresh working capital they sold their holdings, if a purchaser could be found; if not, the shares became delinquent. None of the mines started with any large amount of working capital and even when they happened to be highly productive the directors made but scanty provision for a rainy day. Thus large blocks of shares changed hands with the vicissitudes of the mine, and a few local capitalists, like George Lansell, a most enterprising mine-owner, obtained control of many valuable properties merely by paying calls on shares acquired at the price of a few pence during a period of depression. No mine was developed so as to have any considerable ore-reserve, each company was conducted on a hand-to-mouth policy, so that none of the mines could be appraised on the basis of assured resources. Naturally under these conditions a British promoter found little to invite his financial operations, and British engineers found conditions quite unfavourable to any of the conventional methods of valuation. Each mine was only a prospect on a large scale and in each case the uncertainties were out of proportion to the actualities. At one time a scheme was hatched with a view to acquiring all of George Lansell's holdings, but the death of that veteran prospector and worthy citizen in 1906 put an end to the idea. It was proposed to take over all his holdings, including both the mines that had fallen on lean times as well as those then making fat dividends, and thus to ensure a fair measure of steady productiveness. But even this proposal was attended with many difficulties, it being unlikely that any London administration could have made the most of men and methods peculiar to the district. The time may come when a large system of exploration may be needed to resuscitate some of the exhausted mines; then, in default of local capital, it may become advantageous for the owners to offer terms on which English speculators might have a good run for their money in an attempt to discover new orebodies among those saddle-reefs or anticlinal formations of quartz that constitute the distinguishing feature of old Bendigo.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JUNEAU.

Southeastern Alaska.— Mining operations in this part of the world, while now attracting less attention than formerly, are really being conducted with unusual success. At the same time the foundations are being laid for

The big open-cut at Treadwell.

better things in the future. As usual the Alaska Treadwell group is at the front. Indeed these great mines on Douglas island form the largest single enterprise in Alaska. To date they have produced $43,568,000 and it is interesting to note that whereas for the period from 1890 the general average value of the ore has only been $2·40 per ton, 85c. per ton has been paid in dividends; at the same time millions have been paid from income for plant, development, and power equipment. The story of these mines has been often told, but it may help to make clear the present importance of the enterprise to state that 900 stamps crush 5000 tons of ore per day and that the mines are 1970 ft. deep. There is little mining as yet on the lowest levels since it is the policy of the company to keep development well ahead of stoping and to carry a large reserve both blocked and broken. The latter is easily done since the stopes are worked on the shrinkage system. The average of the ore in reserve at present is higher than the average that has been worked in the past, owing especially to an ore-shoot on the 1600 ft. level of the Treadwell mine that assays unusually well. Probably the total reserve of the available ore would amount to 7,000,000 tons at $3 per ton. This by no means measures the life of the mine, as additional ore can be put into reserve at any time by opening additional levels. Since, however, each level costs approximately $300,000 and six years elapses from the time it is opened to the time when it is abandoned, there would be an unnecessary loss through interest charges if the ground were opened too long in advance. The mines forming the group belong to three companies, the Alaska Treadwell, the Alaska Mexican, and the Alaska United, though the principal owners are about equally interested in all and the management is the same. Hoisting and milling have, however, been done in a number of separate plants and there has been relatively little centralization so far as actual operation is concerned.

Cyanide Plant.—A move toward such a change was the building of a cyanidation plant to treat the concentrate made in the several mills. A part of this plant has been in operation since February, the companies continuing to ship concentrate to the Tacoma smelter of the American Smelting & Refining Co., to complete an old contract. The new plant is actually handling at the present about 80 tons per day at a cost of $3 per ton and with a saving of 96%. The process involves fine grinding in tube-mills, treatment in Dorr classifiers, agitation in Pachuca vats, treatment in Kelly filter-presses, and precipitation in Merrill presses by use of zinc-dust. At first amalgamation was used, following the tube-mill grinding, ahead of the cyanidation, but this was found to be un-

necessary and expensive, and has been given up. W. P. Lass, the cyanide engineer, and Robert Kinzie, the general manager for the company, have scored a notable success in the building and successful operation of this plant. It should be remembered that the material treated is a concentrate made on vanners, and assays roughly: gold $42, iron 40%, sulphur 40%, silica 20%. The residue is being saved. A working test of 20 stamps for one year is being started to determine whether it is commercially advisable to eliminate amalgamation completely.

Deep Hoisting.—Another move toward centralization is the preparation for hoisting from both the Mexican and Treadwell mines through the '700 shaft' of the Alaska United. This shaft, which is centrally located, is being re-timbered and equipped for handling 5000 tons per day from a depth of 3000 ft. The new top works will be built of steel and concrete to avoid the ever-present danger of fire where wood is lavishly used. A new boiler-plant is being built to furnish steam for the Nordberg hoist, which has already arrived. Despite the development of two water-powers on the Island and one across Gastineau Channel on Sheep creek the companies burn as much as 300 bbl. oil per day, even in summer when the most water is available. In the winter 1000 bbl. per day is needed. To avoid this expense the development of the power of Nigger creek, on the mainland, at the side of the Mendenhall glacier, has been undertaken. A transmission line is being built to the side of the power-house and with current sent over this line the new works will be erected and in turn they will furnish power for the mine. This will make it possible to use re-heated air from electric-driven compressors in hoisting and greatly reduced fuel bills.

Silver Bow Basin.—Back of Juneau, in Silver Bow basin, is a great zone of ore, essentially a black slate within which are ribbons of white quartz containing gold. There are three important mines on this belt. The Alaska Perseverance, farthest to the south, has a 100-stamp mill and is preparing to erect 40 additional stamps to be followed by tube-mills. At the other end is the Ebner mine, now controlled by the Nevada-California Copper Co. This concern has already shipped to Juneau a 20-drill compressor and a 200-stamp mill, but having recently lost certain water rights, the work is temporarily checked. Between these two mines is the Alaska-Juneau, which was bought some years ago by the late Capt. Mein, and in which Wernher, Beit & Co. have had a half-interest. The mines have been under Alaska-Treadwell management and recent changes in stock-holding have brought the Alaska-Juneau into even closer affiliation with the Treadwell mines. The Alaska-Juneau is unique as a low-grade mine. Roughly ore worth $1'50 per ton has been mined and milled for $1'09 in a 40-stamp mill operating three to five months in the year. Snow and lack of water-power have prevented a longer working season. Indians have been employed almost exclusively and the ore has been won by 'glory-hole' mining. F. W. Bradley is now examining the property to determine the advisability of enlarging the scale of operations.

Berner's Bay.—In this vicinity the principal work now is that of the Kensington Mines Co., in which W. P. Hammon of San Francisco has become interested. The old properties, which have been in litigation for some years, have been consolidated and are to be reopened. Preparatory work is now being done and in the judgment of numerous mining men there is an opportunity here for the development of another group of low-grade mines of the Treadwell type. The Eagle River mine is practically idle for the time being; although $400,000 has been taken from the property, it is not certain that the vein has ever been worked where the rock was in place. Landslides in the steeply dipping slate, which forms the country rock, have interfered and no continuous orebody has yet been found. The Jualin, a smaller property containing ore that is worth $25 per ton, is likewise idle, in this case owing to disagreement among owners.

Other localities.—At Atlin, in British Columbia, the season has opened and J. M. Ruffner of the North Columbia Gold Mining Co. has 15 hydraulic giants at work. Farther south near Ketchikan, mining is quieter. The reported deal of the United States Smelting, etc., Co. for the Mt. Andrew mine failed to go through owing to disagreement as to price, though the examination showed a good body of valuable sulphide ore to be present. The Ib and the Sulzer mines near-by are both shipping regularly. Farther west near Sitka the Chichagoff mines are attracting attention; though not so large as the Treadwell they are valuable properties yielding rich ore. Bratnober, Rust, and Jarvis, have done well with the De Graff; and the Golden Gate, owned by W. P. Mills, is reported to be in an equally satisfactory condition. The suicide of Captain D. H. Jarvis was particularly deplored here, at Juneau, where he was so well known and so generally liked.

THE EAGLE RIVER GLACIER, AND MINE, ALASKA.

TORONTO.

The Porcupine district has again been visited by a bush fire, which, owing to the exceedingly hot and dry season devastated a large area and was with difficulty prevented from extending to many of the buildings. The plant of the Dome Extension was destroyed causing a considerable loss, and other properties were only saved by strenuous exertions. The lives of Capt. Anchor of the Dome Extension and a number of men were in great danger, and several of them were severely burned in fighting the flames. These fires, however, are regarded by others than the immediate sufferers as blessings in disguise, as the clearing away of the forest growth renders prospecting and the tracing of rock exposures much easier. The known gold-bearing area of the district has latterly been considerably extended by new finds, and the whole country as far as Sudbury is overrun by an army of prospectors. A great rush recently took place to Bristol township where a noteworthy discovery was made by John Bridge, a former Cobalt miner, at a point about ten miles southwest of the Hollinger mine and near the Mattagami river. A well defined vein about 200 ft. wide with good gold showings was found on one of two rock exposures. The remainder of the neighbourhood is all under swamp but has nevertheless been staked in all directions in the hope that something of value may be found.

At the Rea the main shaft is down 240 ft. and will be sunk to the 500 ft. level, with development carried on at the intervening levels, drifts being run to tap the orebody in the main lode. A second shaft is being put down, to be connected with shaft No. 1 at the first level. A rather spectacular find has been made on a property owned by the Armstrong-Booth syndicate just south of the Rea. Free gold has been panned in considerable quantities from the loose dirt beside numerous stringers. The Preston East Dome is opening up a 15 ft. vein on one of its properties adjoining the Dome. The Bewick-Moreing syndicate has established two more camps, known as No. 3 and No. 4. The former is situated on the properties adjoining the Dome Extension to the north and east, and the other on the Timmins group in Deloro township. The men are at present engaged in stripping. The Porcupine Investors, a company organized in London with a capital of £1,500,000, has purchased three claims lying north of the Dome and North Dome, and has let contracts for drilling preparatory to undertaking development. The Porcupine Canada Gold Mines, another new company representing German and British capital promoted by Baron G. von Polenz, has several Porcupine claims under option; these are being investigated by engineers. The Imperial has sunk to the 100-ft. level and recently struck a good vein 6 to 8 ft. wide. The Foley-O'Brien has discovered a vein in a drift at the 160-ft. level, intersected with rich stringers showing free gold. The Achilles, a Montreal company, has a good showing in a 7 ft. vein found at the 125-ft. level on its property to the north of Porcupine lake. The Porcupine branch of the Temiskaming & Northern Ontario railway is now open for traffic and large quantities of freight are going forward.

Cobalt.—Comparatively little interest is being taken in Cobalt and not much news comes from that quarter. A new vein of high-grade ore has been cut by the Nipissing in a cross-cut from shaft No. 123 at the 100-ft. level, near the O'Brien line. The find is regarded as significant, being the first practical result of development in the Keewatin formation in that part of the property. No. 12 shaft has been pumped out and good ore is being extracted. The La Rose continues to improve its position. The total output for the five months ending May 31 was 1,522,580 oz. silver of a gross valuation of $802,677. The profits amounted to $535,132. At this rate the mine is earning more than double its dividend requirements. It has a present cash surplus of $1,300,000. The Nova Scotia is getting good milling ore from a shoot 40 ft. long and 4 ft. wide on the 150-ft. level. A 10-stamp mill has been ordered by the Wettlaufer in the South Lorrain area, where transportation difficulties prevent the shipment of low-grade ore at a profit. The capital of the Trethewey has been increased from $1,000,000 to $2,000,000.

Coal Mining.—A recurrence of the landslide catastrophe of 1903 at Frank, in Alberta, where a number of lives were lost, is seriously threatened. R. W. Brock, the Director of the Canadian Geological Survey, reports that cracks have appeared in the rocks on the northwest shoulder of Turtle Mountain overlooking the town, and that any further work on the coal seams below may precipitate a disaster without warning. The mountain has been inspected by the Survey since the former landslide, and it has been noticed of late that the fissures have widened. The mine is operated by the Crow's Nest Pass Coal Company.

The colliery at Port Hood, Nova Scotia, owned by the Port Hood & Richmond Railway & Coal Co., has been flooded from the

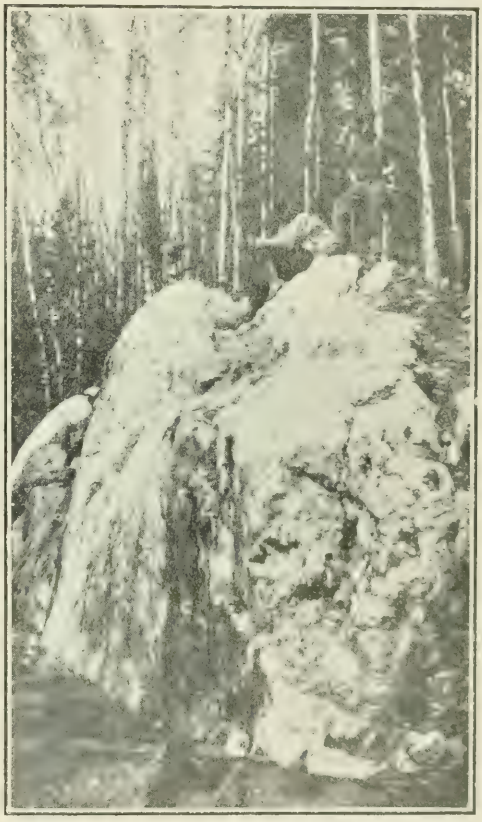
Atlantic and is to be abandoned, reclamation being considered impossible. The Dominion Steel Corporation is operating a new colliery at Birch Cove and has started the construction of a railway about four miles long to connect the colliery with Morien Junction. When transport is obtained a new slope will be sunk and mining actively resumed. It is expected that shipments will be made before the close of navigation.

James Douglas, of New York, has made a donation of $50,000 to Queen's University, Kingston, as he some time ago promised to do, on condition of its being freed from denominational control.

SAN FRANCISCO.

Alaska.—Interest on the Pacific Coast now chiefly centres in the Alaskan coal lands and the California smelters. The Cunningham group of claims were finally rejected, thus vindicating Gifford Pinchot and his subordinates, and discrediting Ballinger. As the matter now stands, not only the sequestration of these valuable coal lands has been prevented, but it has been established that there is at present no practicable legal method of developing the coal resources of Alaska. As a result feeling runs high here, although the seriousness of the situation has been greatly magnified, in the interest of the corporations engaged in exploiting Alaska. In spite of the evident demand for constructive legislation that will permit the development of the coal mining industry in this area, there is no possibility of any being enacted at this special session of Congress, as the Democratic majority in the House is determined to allow nothing to divert attention from Canadian reciprocity and the wool schedule. A lively scandal has developed over the harbour of Controller bay, one of the two outlets for the Alaskan coalfields. One R. S. Ryan came to Washington at the time the Chugach National Forest was created, and persuaded the authorities to exclude the shores of Controller bay from the Forest. Then he and his associates filed upon it, obtaining control of the harbour. Now it appears that Ryan was acting in behalf of the Guggenheims, and that when he saw President Taft, who asked him whom he represented, he claimed to be acting independently. President Taft was not satisfied with this, and finally Chas. P. Taft was induced to call on the President and influence him to accede to Ryan's request. The matter has been greatly exaggerated by an irresponsible Press, but the present administration will certainly derive little credit from it. The appointment of W. L. Fisher as Secretary of the Interior was hailed as a victory by the forces that have opposed the monopolization of Alaskan coal resources, and it is not unlikely that they will in the end prevail. Meanwhile the Guggenheim syndicate controls Cordova and Controller bay, the only outlets from the coalfields.

Smelter fume. On June 20 the case of the Shasta county farmers against the Balaklala smelter was heard in the United States



Outcrop of the Hollinger lode on the Miller-Middleton claims.

Circuit Court of San Francisco and Judge Morrow affirmed the injunction closing the smelter. The smelting company was allowed 35 days more of operation, so that it might use up the stock of ore and coke already on hand. This is an unmerited blow to the Cottrell process, which had been employed at this plant for removing the solid particles from the fume. A. H. Trotter, superintendent of the smelter, has recently given out a statement saying: "The experiments on unit 5 of the Cottrell plant have been a complete success, and have fully demonstrated the adaptability of the

Cottrell system for the elimination of solids and SO_3 from our gases. At the present time it is effecting a very satisfactory clearance of the solid particles, and it can be made to do better work at comparatively small expense. The Cottrell system will do all that has been expected from it and I wish to be distinctly understood that I have never stated that it has been a failure or a loss to this company. I believe that the management of this company is well satisfied with the operation of the Cottrell plant."

The Cottrell process has also been successfully applied to the removal of water from crude petroleum, the rights to the process for this use having recently changed hands at a high figure. The Balaklala is a well developed mine, with an ore reserve of about 2,000,000 tons, averaging 2·65% copper, together with gold and silver. The situation of the shareholders is a serious one, as the present selling price of the shares represents a loss of $6 to $8 per share.

Oil. The large demand for kerosene and gasoline for the Oriental trade has greatly increased the importance of the Pacific Coast oil industry. Rumours have been industriously circulated concerning the advent of the Shell interests into this field, the latest being that the latter are about to construct a refinery at Martinez, California. It is also reported that the Standard Oil is about to construct a million dollar distributing plant at Richmond Beach, on the shores of Puget Sound, and that the Shell syndicate will also erect a competing station. Reports from the Katalla oilfield, of Alaska, are to the effect that five wells are already producing and several drilling rigs are ready to start. A pipe has been laid from the old English property to the storage tanks. At Katalla a small refinery has been erected to furnish gasoline for local consumption.

Copper.—The campaign against the Utah Copper Co. seemed to produce but little in the way of results. Recently the ferocity of the attack on this company has increased, but the market has refused to be impressed thereby. Early in July the *Mining and Scientific Press*, in a long editorial, drew attention to the good work done by the company's engineers and the injustice and unreasonableness of the attack made upon them. The monthly report of the Copper Producers Association for June was favourable, the production having decreased 2,000,000 lb., as compared with May, while stocks on hand decreased 8,500,000 lb. As European purchasers are expected to take large amounts during July it is not improbable that a further decrease will result during the month. The market is now firm with electrolytic quoted at New York at 12·48c. Just before leaving for Europe, Daniel Guggenheim gave out an interview in which he expressed the opinion that a 'runaway' might be expected from the present decrease of stocks and production. A howl of derision has gone up, and the general opinion is that Mr. Guggenheim's imagination has run away with him.

Recent reports from the Chino and Ray properties are to the effect that 6,000,000 tons of ore averaging 2% copper has been added to the Chino reserve, giving a total of 50,000,000 tons. The power-plant is nearly finished and the first section of the mill is expected to start in September. The mine-work is well in hand and the management will soon be able to produce 5000 to 6000 tons of ore daily by steam-shovels. In the Ray over two miles of underground work has been done in the past year, and the system of stoping employed has been entirely satisfactory. Three sections of the mill are now in operation, treating 1100 to 1200 tons per day each. Oil is being substituted for coal, as fuel, in the power and smelting plants.

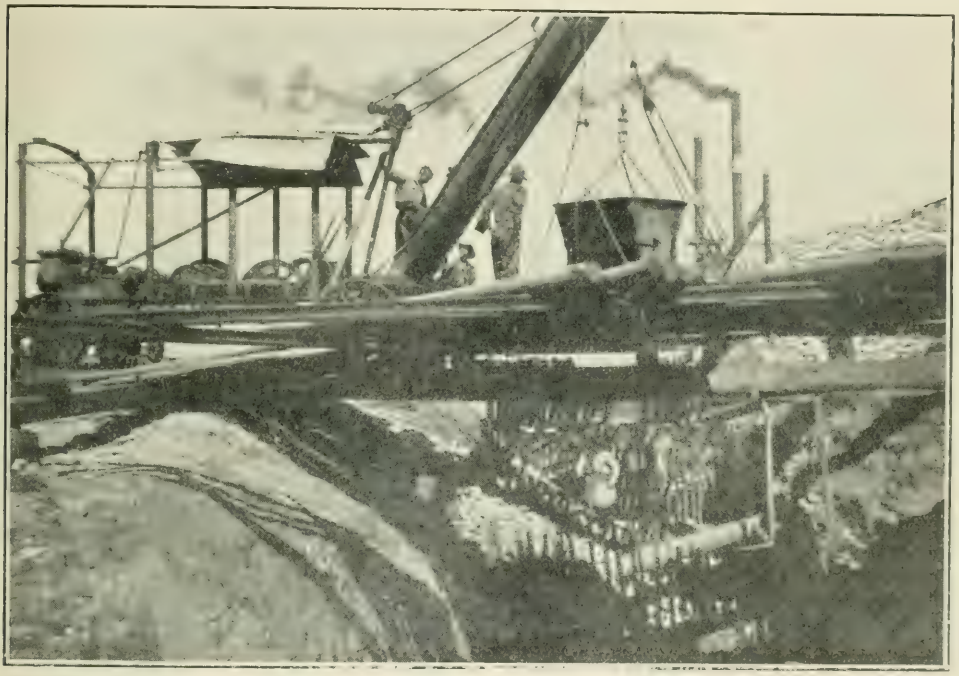
JOHANNESBURG.

Standardization on the Rand is conspicuous by its absence, from the policy adopted by the directors of the various groups down to the method of placing a piece of timber underground. For instance, about a year ago, a deal of excitement was caused by the 'square fathom' scheme, evolved ostensibly by the consulting engineer of one of the largest groups. The new policy was to revolutionize things on the Rand. Low costs did not matter, profit was the aim, combined with narrow stope-widths and close sorting. In other words the eyes were to be picked out of the mines. Yet now that a year has passed a director of the group that inaugurated the 'square fathom' scheme, when speaking at the general meeting of another large group, says that the ideal method of working is to take everything as it comes and work the mines so as to yield an average grade and prolong the life of the mine as long as possible. This variation of policy may be all right from the share-market standpoint, but it certainly does not tend to improve the actual working of the mines, since each variation of policy is apt to cause a change in the personnel of the staff, followed by an unsettled feeling, extra expenditure, and waste of time. So much for a change in policy. The same

applies, only in smaller degree, throughout the detailed working of each mine. For example, in underground work, it may be proposed to run four large machines 1000 ft. from the main air-column. One man thinks a $1\frac{1}{2}$ in. pipe will be sufficient to supply all the air required; $1\frac{1}{2}$ in. pipe is therefore used. Everything is ready and it is found that only 3 machines can be run off the $1\frac{1}{2}$ in. pipe with the pressure available. Another man might advocate 2 in. or even 3 in. piping. Of course the size of pipe required can be worked out by formula, yet in cases of this kind it would be much handier if certain standards were established, only by one group, in order to increase efficiency and save money.

City Deep.—At the moment of writing the price of City Deep shares is falling rapidly and they now stand at about 65s. This can only be due to the fact that with the change in management, together with the change of resident mechanical engineers, it has been discovered that the magnificent new plant has serious defects that require remedying before it can run smoothly. The mill will require several expensive alterations. The hoisting engines, in so far as the ropes are concerned, are giving trouble. There is a shortage in electric power, so that it has become necessary to revert partly to steam. The new manager is James Morris, late of the East Rand Proprietary, and the new mechanical engineer is H. L. Templar, late of the Ferreira.

Ferreira.—The accompanying photograph illustrates the open-cut operations still proceeding, right in the town of Johannesburg, although the mine was started in 1888. The open-cut work chiefly consists of taking out the surface pillar, about 40 ft. wide, by underhand stoping from the surface. The trucks are either run on old filling or on stulls below the pillar; when filled they are slung by means of chains from the rope shown in the photograph and hoisted bodily by an old steam navvy. As the ground is stoped out it is filled again with waste from the dump.



WORKING IN THE OPEN-CUT AT THE FERREIRA.

Dust and Phthisis. — Experiments are still being made with various methods for overcoming the dust trouble. The success of hammer-drills and the fact that they require only one boy to manipulate them, and also their suitability in back-stoping the ground left in the older mines, has tended greatly to increase the number of dry holes. This being the case it is imperative, not only to minimize the dust but also the operating cost, that some method be adopted by means of which all dust is eliminated and the drilling itself facili-

tated. The latest idea is the one under trial at the Nourse mines, where pipes conveying water under pressure are laid down throughout the mine, so that water can be injected alongside the drill while the machine is running. This kills the dust and also favourably affects the drilling.

Machine-Drill Stoping. — Interesting figures are to hand showing the results of stoping with small reciprocating machine-drills as compared with large machines and hammer-boys at the Robinson Deep mine. The comparative figures are as follows:

	Cost per fathom s.	d.	Stope-width Inches	Work done per shift Fathoms	Tons
By hand	80	4·7	51·1	0.076	0·915
By small machines	75	7·2	54·7	0·55	6·432
By large machines	72	9·8	59·9	0·63	8·410

From the above figures it appears that the cost of hand labour is above the average; 0·076 fm. per boy-shift is bad. This figure should be about 0·1 fm. in good ground and with good hand-stopes. The small machines do comparatively well and the ground must be easy to obtain these results. From a labour point of view a small machine requires the same number of boys as a large machine, and except in stopes where the hanging is bad and a large machine would shake the ground too much, they will not bear comparison with large machines, even when it is required to keep the stope-width as low as possible. The figure 0·63 fm. per large machine is also much below the average for a stoping-width of about 3 ft.; this figure should at least be in the neighbourhood of 0·75 fm. per machine per shift. In March 1911, 44·55% of the ground broken at this mine was done by small machines, 31·84% by hand, and 23·61% by large machines.

The Butters Filter.—An official report is just out dealing with the results obtained from the trial of the Butters filter at the Crown Mines. The broad result is that the Butters plant has been taken over as a permanent feature of the Crown Mines equipment and is also to be enlarged to a capacity of 1200 tons per day. The report gives the following interesting information:

(1) The true average of Adair-Usher residue was shown to be 0·423 dwt., whereas the average of tank samples, taken in the usual way, gave 0·225 dwt. per ton. (2) The Butters filter made a total recovery of 0·333 dwt. per ton from Adair-Usher residue averaging 0·423 dwt. To quote the report: "The conclusion reached from this six months trial may be stated as follows: (1) Owing to the fact that in the past Adair-Usher residues have been considerably under-estimated, as confirmed by recent investigation, the filter may reasonably be expected to show a net saving over the Adair-Usher process of from 0·20 to 0·5 dwt. per ton of slime filtered. (2) Under normal conditions the filter may reasonably be expected to show a gross saving over the decantation process of about 0·20 dwt. per ton, or a net saving of about 0·12 dwt. per ton, of slime filtered. (3) As regards cost of treatment this has been given at 9d. per ton during the earlier stages of the trial."

MEXICO.

Pearson Oil Interests.—Rumours of the contemplated sale of the Pearson holdings in Mexico to the Texas Oil Co., headed by John W. Gates, are persistent, notwithstanding a recent denial by Lord Cowdray. Following the recent examination of Pearson holdings by officials of the Texas Oil Co. and the Gulf Refining Co., Pearson officials in Mexico City admitted that the purchase of Pearson crude oil for shipment to the United States was contemplated, and that the holdings might pass to American interests in the event of an agreement on price. It has been reported that the present government of Mexico would object to the transfer of the Pearson concessions as they now stand, but this report lacks confirmation. Finance Minister Ernesto Madero, uncle of Francisco I. Madero, the revolutionist leader, stated recently in an interview that the provisional government was not conducting an investigation into the affairs of any corporation, and that all rights held legally by corporations would be respected. When the American oil-men recently visited the Potrero field in the State of Veracruz they were given a view of the great Pearson gusher in action. It required the efforts of three men to open the gate-valve holding the Potrero monster, and the gusher was allowed to perform for 20 minutes. Oil was thrown to a height of 491 feet, and the flow was estimated at 100,000 bbl. daily. In the earthen reservoir into which the flow of the well was finally turned after it had flooded the surrounding country, the Pearsons have 3,000,000 barrels of oil. It is a mile around the reservoir, and at places the oil is 30 ft. deep. The capping of the gusher was an herculean task, and much time was consumed in accomplishing it. The Pearsons have two stretches of 6-in. pipe-line between Potrero and the Gulf port of Tampico, one extending from the field to the Tamiahua lagoon, and the other from the lagoon to

Tampico. Barges carry the oil for some distance on the lagoon. The pipe-line will be made continuous by the building of another link, and an 8-in. pipe-line will be built from the oilfield to the Gulf port of Tuxpan. Besides the big gusher, the Pearsons have five wells in the Potrero field, two of them intermittent gushers.

Other Oil Interests.—The first shipment of Mexican crude oil to the United States was made recently by the Huasteca Petro-

The Potrero Gusher.

leum Co., a subsidiary of the Mexican Petroleum Co., Ltd., of which E. L. Doheny is the head. The shipment amounted to 32,000 bbl., and was carried by a Standard Oil Co. steamer from Tampico to Sabine Pass, Texas. It is reported that the Huasteca Co. has entered into a contract to supply fuel-oil for the Southern Pacific locomotives in service in Texas, and that 8000 bbl. daily will be required. The Mexican oilfields now are attracting more attention than ever, and much exploration and development is in progress.

Ocampo.—The future of this mining region, including Concheño, Pinos Altos, and Candameña, depends mainly on the supply of motive power. The country has been mined for so many years that all the cheap wood has been cut, the cost now being from $4 to $7 per cord at the various camps. There is a project to erect a plant at the Basaseachic falls, owned by the Sierra Mining Co. These falls have a vertical drop of 980 ft. and with suitable storage arrangements 3000 hp. may be developed there. The same company is now building a 300 hp. wood-steam-electric plant in the forest about six miles from the mines, where wood is available for a few years at about $2 per cord. This is, however, a temporary makeshift.

At Concheño in the Saragossa mine a considerable tonnage of about $30 ore has been developed within the past year, and several hundred thousand tons of $6 to $8 rock, which is just too low-grade to treat. The 60-stamp mill is about to be started on the good ore. The working cost is not much less than $10 per ton. At Pinos Altos an indefinite (owing to the caved condition of the mine) tonnage of ore of about $6 grade could be profitably treated with cheap power. A 40-stamp mill exists and there is talk of trying to run within the next year or so. Both this ore and that of Concheño show good recovery by sand-leaching with cyanide, say, about 80%; and 90% or better can be extracted by sliming and filtering. The ores carry almost equally well in gold and silver, the gold being mostly free and the silver as argentite, with more complex sulphides, sulph-arsenides and sulph-antimonides. There is little or no copper.

Candameña is quite a different proposition. The ores are chiefly valuable for silver, but they are base and complex, having pyrite, galena, sphalerite, and copper as tetrahedrite and tennantite. Hence the camp has been slow in development, though there are several mines in Candameña that show quite high-grade, though small, veins. At Socorro the ores are gold-bearing only. The veins are small, with an occasional bonanza. 'High-grading' or stealing is common—too much for the amount of ore. The International Gold Mines Co. has a beautiful plant at Socorro, but not enough ore to operate profitably, so it had to be shut-down. At Cienega a little farther west, individuals have developed a fine little mine from virgin ground. This mine—the Cienega—will show a nice profit if carefully worked. It also is straight gold, and has had the distinction of paying its way from the start first with an arrastra and then with five stamps. At La Republica—farther west still

—a high-grade shoot of silver ore is being worked, but it involves the handling of more water than any other mine in the upper Sierras. They mill ore running up to $50 per ton and show only a small operating profit.

MELBOURNE.

The Tanami goldfield in northwestern Australia has not developed rich ore and consequently, owing to its inaccessibility, it is one of the regions that will have to await the spread of civilization. The Warden, Lionel C. E. Gee, is one of the pioneers of industry in the great desert country of Australia. As showing the type of man he is, when he contracted beri-beri, an ailment prevalent in the highlands of Central Australia, he never shirked the performance of his duties. The disease is accompanied by a swelling of the legs, and if it extends upward and touches the heart, death is almost instantaneous. In Mr. Gee's case the swelling had reached the thighs, but as he put it: "A man can only die once." He was in no pain and work had to be done, so, although he did not know the moment that his heart might be affected, he was carried to the Warden's Court, where he fulfilled his duties as serenely as if the hand of death were not half-extended toward him. Mr. Gee has issued a report upon the Tanami field in which he says that personally the place interested him very much, and its possibilities impressed him strongly and favourably, which impression time and further acquaintance with the field had deepened. Alluvial gold-diggers and specimen-hunters, he said, are proverbially secretive, but he ascertained that up to the end of the year 1909, about six months of intermittent work by a handful of men had produced over 1000 ounces of gold, the value of which he estimated at about £4000. This included specimens and alluvial gold, the largest nugget weighing 11 oz. 17 dwt. As a matter of fact no profitable alluvial ground has been discovered except the small area known as 'The Patch' on the Reward claim and the two adjoining blocks. The workings are situated 3 miles eastward from what are known as the 'rock-holes.' These rock-holes are in a deep gorge of a large cliff-like formation. They are difficult of access and only contain a limited supply of water, and the quality not too good at that. However a good supply of water was struck later by sinking about 150 ft. six miles north. Laurie, one of the leading prospectors, showed Mr. Gee some fine specimens from the Reward claim. About 67 lb. weight of ore from the claim adjoining Laurie's protected area yielded 100 oz. gold. Little in the way of prospecting work has been done, but by pot-holes and costeens the mineral belt is proved to strike about N 35° E. The formation consists of quartz, gossany quartz, ironstone, and felsitic dikes. It is evidently of considerable width. At Laurie's claim it has been traced on the surface 100 yards wide, and appears to dip northwest. It is generally believed that, on crossing the watershed of the Victoria river southward, the fever country is left behind, for then the steamy heat so associated with fever gives place to a dry clear heat, the fever attacks from which some of the men suffered and in some cases died, being considered to be returns of fever contracted farther northward. As far as can be judged, December, January, and February are months of intense and continuous heat at Tanami, the thermometer ranging from 100° to 112° in the shade most of the time. However, the heat is dry, burning, clear, and not unhealthy, with every day a breeze of varying strength from the southeast. Owing to the elevation of the country the nights are cool, making sleep natural and refreshing. Mr. Gee comments on the wonderful brilliancy of the stars in that clear atmosphere, and adds that Halley's comet was a magnificent and awe-inspiring sight, stretching about 45° across the sky.

Mining Accidents.—The state of New South Wales some time ago decided that it would establish a fund for the relief of miners who might meet with accidents, both employers and workmen contributing to the fund, in addition to the Government. The payment per man is 4½d. per week, or say £1 per annum, and for each man the employer has to pay 10s. per annum, and the Government adds a similar amount. The scheme is somewhat on the lines of the Lloyd George scheme of national insurance. The fund has been in existence about 10 years and has proved a magnificent success. During that period 381 adult relatives of persons killed received benefits for more or less extended periods, and 306 claims are still operative; in addition, benefits have been paid in respect of over 1000 children. The total number of non-fatal accidents during the ten years was 45,108. Altogether over £231,000 was paid in benefits. In the case of death resulting from accident any senior dependent on the deceased receives 8s. per week, and 2s. 6d. per week in respect to any children under the age of 14 years left by deceased. An allowance of £12 is made for funeral expenses. In the case of the employee being

incapacitated from attending to his ordinary duty, he receives 12s. per week while so disabled. What these benefits represent will be readily appreciated by those who have had experience in mining centres. Haphazard collections and spasmodic charity provide, as a rule, quite inadequately for those who may have had the misfortune to lose the bread-winner, or to suffer personal permanent disablement. An actuarial examination as to the condition of the fund was made as on April 30, 1910, taking into review the records for over 9 years. An extract from the report is of interest: The following annual rates per 1000 miners are deduced from the experience of the fund, relating to a total of 221,863 miners for one year.

		Per 1000 per annum
Miners killed by accident		2·344
Widows and dependent adults		1·623
Children, fatal cases	3·119	
Children, disablement cases	1·163	
		4·282
Miners permanently disabled		0·965
Miners temporarily disabled		183·000

The balance-sheet for last year shows how the scheme works. The amount deducted from wages was £23,728 and the owners' contributions amounted to £11,174, the subsidy by the Government being the same. Allowances to beneficiaries absorbed £35,565, and managerial expenses about £1500, leaving a cash balance of £259,000, of which £257,000 is invested for the benefit of the fund.

Queensland.—The official figures giving the mineral production of Queensland show that the total income from this source for the year was £3,710,222, or £53,658 more than in 1909. The decline in the gold yield continues, this year's return being £1,874,955, or £60,220 less than a year ago. Unfortunately, developments have not resulted in much promise of this metal increasing its proportion of the total mineral return. However the success that has attended to re-opening of the outside mines at Charters Towers encourages the hope that attention may be profitably turned to parts of the district outside the small area in which work has previously been centred. The most interesting feature in the return is the growth of the copper production since 1901. During this time the value of the copper output has increased from £194,227 to £932,489. The smelting industry has become the mainstay of the Queensland mineral production, a large proportion of the gold and most of the silver coming from this source. Of last year's gold output 30% came from metallurgical works. The new Hampden-Mount Elliott railway was particularly beneficial to an important copper-gold district, and a large railway construction scheme now announced by the State Government promises much in further developing the mining industry.

Mount Elliott.—The smelter at the Mount Elliott copper mine, Queensland, is to be shut-down for two months, August and September. The reason for this is that a vugh channel has disturbed the course of the ore at the No. 3 level, extending to the No. 1 and 2 levels, and the management thought it best to shut-down the smelters while the necessary repairs were made underground. A 'vugh' is a large cavity in a lode, and is practically what a cavern is in mother earth. Usually these vughs are of insignificant size but this one extends upward something like 200 ft. A couple of years ago a short run with the old smelter gave about £60,000 worth of copper. Then it was decided to erect a larger plant, and the present operations have maintained a satisfactory output since the smelting started in September last. For the nine months ended on May 31 the company treated 38,193 tons of ore for 4866 tons of copper, 9095 oz. gold, and 5116 oz. silver, representing a total value of about £280,000, and leaving a handsome profit. The company has spent a lot of money in mine development and installation of smelters, besides the construction of the railway, which the Government has now taken over, repaying the outlay incurred. The ore reserves at Mount Elliott have been estimated to contain metals to the value of over a million. The diamond-drill bores have not yet cut any large bodies of ore in the deeper ground, but as the lode is erratic, it is more than likely that the ore has been missed. Much dissatisfaction was expressed by shareholders in Australia because the directors in London did not issue this information here at the same time as in London.

Chillagoe.—The directors of the Chillagoe company have been making a tour of their mining properties in Northern Queensland. This company is largely backed by British capital, which has provided the best part of a million pounds for the mines, railways, and works. The directors visited the Chillagoe and the other mining districts in which the company has become interested, chiefly along its 250 miles of railway. These include the Etheridge and Oaks goldfields, and it is more

than likely, owing to the discovery of coal at Mount Milligan, they will shortly embrace the Hodgkinson goldfield as well. They expressed themselves well pleased with their visit, and with the prospects throughout the area inspected by them. Among the mines acquired, the Nil Desperandum, Queenslander, Havelock, and Big Reef have been formed into a separate company, under the same management, called the Etheridge Mines, Ltd., with an available working capital of £33,000. A concentration plant is to be at work by the end of the present year. The ore is highly mineralized and while unsuitable for ordinary battery treatment, is amenable to concentration.

CAMBORNE.

Wheal Kitty & Penhalls is as usual the first of the Cornish companies to issue the half-yearly report and statement of accounts. The profit for the six months ended June 30 was £1876, and dividends of 5 and 10% respectively were declared on the ordinary and preference shares. The working cost is up sevenpence per ton and now stands, including royalties of 1s. 5d. per ton, at slightly over 25s. The increase is largely due to the higher wages paid, owing to the dearth of miners in the district and to the competition consequent on the enlarged scale of operations on adjacent properties. The equipment of Sara's shaft to the 540 ft. level is nearing completion, and the 65 in. Cornish engine with 18 in. pitwork should handle all the water likely to flow into these workings. A cross-cut south from this shaft toward the old mine has recently intersected the Stamps lode on the other side of the main cross-course; at the point of intersection it is 18 in. wide and averages 84 lb. per lb. per ton. A large amount of ground on this lode will now be available for development. Its discovery definitely proves the heave of the main cross-course, and it is clear that the shaft will not have to be sunk so deep as was expected; in fact another 24 fm. of sinking should reach the Wheal Kitty lode, for which the shaft is mainly being sunk.

East Pool & Agar.—The accounts for the past quarter presented to the shareholders at their meeting on August 8, show a profit of £90. The dues payable to Mr. Basset on the East Pool section amounting to £203 have not been charged, as that amount has been contributed by the 'lord' to the sinking of the engine shaft. This is a misleading way of dealing with the matter in the accounts, where the cost per ton is shown to be lower than it really is. In the case of the Wheal Agar section, dues payable to Viscount Clifden amounting to £65 are charged. The development work continues to be ridiculously small for a mine with an output of over 50,000 tons per annum. For the quarter under review, 243 ft. of ground was opened up, which is a reduction on the previous 12 weeks, but as all available funds are being spent on shaft repairs and pump-work at Agar, the managers are in a difficult position in this respect. It however shows clearly one of the weak points in the cost-book system as applied to a large mine, for if vigorous development had been continued for the past 12 months the company would by this time have been reaping the results and taking full advantage of the high price of tin. By the time the repairs to the shaft and the pump-work are completed, tin may have had a fall and then the shareholders will 'feel a draught.' Had the committee of management had the pluck to make small calls to provide funds for development, by this time the price of the shares would be much higher than at present, and what is more the rise would have been justified. The tonnage crushed was 13,722, and the production 110¾ tons of black tin, the average recovery of tin and wolfram being 19 lb. per ton treated.

Grenville United.—The accounts of this company are being awaited with interest, for the news from the property is distinctly cheering. The produce per ton has risen by 8½ lb. per ton since March last, and the sales by 13½ tons of black tin, while the receipts have increased nearly £1900 per month. The profits per month of four weeks are now probably not less than £2000. The manager's return to the old method of giving monetary values to the stopes, etc., is to be regretted, for this method is not illuminating to the average shareholder. Pounds per ton is the only intelligible way of reporting tin-lode contents, for this enables the shareholder to appraise the value for himself. Such a relapse on the part of Captain Battens is inexplicable, for he has introduced several improvements in the business management of Grenville since his appointment. It is to be hoped that some shareholder will protest at the forthcoming meeting of the company.

At Gossmoor the new steam-plant is to be formally started next week. A trial run has been satisfactory and it is to be hoped that the result may be to establish a successful alluvial proposition in Cornwall. J. H. Collins, who first tested the ground, is confident, with the price of tin much lower than at present, that the business will be profitable.

NEW YORK.

Market quotations on mining stock, if they truly represented the condition of the industry, would justify the most acute apprehension. For no discoverable reason relating to the actual condition of the properties, the shares of such old reliables as Anaconda and Tennessee Copper have suffered severely within the past month, the actual losses being: Amalgamated, $4\frac{1}{8}$; A. S. & R., 3; Chino, $1\frac{1}{4}$; Miami, $\frac{3}{4}$; Nevada Consolidated, $1\frac{1}{4}$; Ray, 1; Tennessee, $1\frac{1}{2}$: Utah Copper, 2 points. These falling prices were registered during periods when trading threatened to disappear entirely; in fact, a new low level for a day's volume of transactions has been recorded within the month. As to the sudden and spectacular drop in Nipissing, this is generally explained by the possibility of the next customary extra dividend being omitted, but the real reason is that a few of the principal holders of the stock were under the necessity of realizing immediate cash. As in the case of other shares, the drop is not taken to reflect on the earning ability of the property.

Reciprocity with Canada now seems to be assured. The Senate has at last acquiesced in the popular demand for better trade relations, and the United States now stands committed to its side of the contract. In Canada, a certain amount of opposition appeared in the Legislature, and developed to such an extent as to lead the Governor-General, with the advice of the Premier, to dissolve Parliament. Elections on the single issue of reciprocity will occur in September, and the present indications are that it will be supported by a decided majority. In that event, the actual provisions of the treaty will go into effect about next November. Aside from the general public advantage of cheaper supplies of food to be secured from Canada, our interest lies principally in the importation of lead ore and bullion from British Columbia, iron ore from Ontario, and coal from Nova Scotia, the last being received with special gratitude by manufacturers in New England. The Pacific Coast, likewise, will enjoy the advantage of cheaper coal from Vancouver island and the Canadian Rockies.

The American Smelting & Refining Co. reports for the year ending April 30, 1911, that its total net earnings, after allowing $750,000 for depreciation, amounted to $6,660,000, out of which $5,500,000 was distributed in dividends. In the 12 years of its existence, the company has paid dividends amounting to $58,463,000, and has accumulated a surplus of $17,640,000, after spending $10,000,000 for repairs and replacements, and allowing $7,600,000 for depreciation, including new construction. The present value of the company's property is estimated at $75,000,000, and of its investments in the securities of other concerns, at $18,086,000; its current assets at the end of the year were $22,360,000. The net income was $380,000 less than that of the preceding year, due partly to an increase in the amount written off for depreciation, and partly to diminished income from mining operations; the company's mines are all in Mexico and are not worked except when necessary to offset deficiencies in the supply of custom ore. By the purchase of 122,500 outstanding shares at $60, the Smelting & Refining Co. now owns the entire £30,000,000 common stock of the American Smelters Securities Co.;

Chinipas, Mexico.

the other obligations of the Securities Company include $47,000,000 of preferred stock and $15,000,000 of 6% bonds. In a similar manner, the Smelting & Refining Co. during the past year secured entire ownership of the United States Zinc Co., and a larger interest in the National Metallurgical Company of Mexico. It likewise paid off the last of the bonds of the Omaha & Grant smelter and now has no bonded indebtedness against any of its property. The company's smelting plants have a combined capacity of 5,500,000 tons and its refineries of 460,000 tons per year. Its control of the Smelters Securities company also gives it an additional smelting capacity of 2,650,000 tons of ore, and a further refining capacity of 190,000 tons per year.

The copper market remains firm, but it is hopeless to expect any marked or general

advance in prices. It is equally improbable that prices will drop much below their present level, in spite of the anticipated additions of metal from new sources. Careful estimates on the capacities of the forthcoming producers indicate that the output for 1912 will exceed that of the present year by about 200,000,000 lb., or approximately 10% of the normal present production. After this shall have been accomplished, no further sudden increase in the world's production is to be anticipated, as no large copper-bearing territories other than those included in the foregoing estimates are at present under exploitation. A certain amount of encouraging exploration is going on in Central Africa, but it will be many years before metal comes from there in quantity. It is now generally conceded that the expected influence of the 'porphyry' production on the market was greatly over-estimated. The porphyry copper has made its appearance so gradually that the market has been able to absorb it without signs of distress; consumers waited a long time for the distress to occur, but finally became convinced that prices could be maintained at no lower level. Miami and Ray are now producing, and Chino will begin before the end of the year. The managers of the Braden mine expect to have the first section of the 3000-ton mill in operation shortly; the second section will be started in October, and the third in December, if nothing fails. They have been experimenting on a leaching process, and speak rather confidently of 7-cent copper. At full capacity, they count on producing 37,000,000 lb. per year. In this connection, an interesting technical point has been brought out at the Miami mill. The fine-crushing rolls installed in section No. 4 for some reason failed to yield the expected results; a certain amount of rubbing action seems to be required to liberate all the chalcocite in the ore, which the rolls do not give. In sections No. 5 and 6, therefore, the old reliable Chilean mills are being installed, while section No. 4 is being retained as an experimental laboratory, and is now being equipped with a large Hardinge mill to replace half of the rolls. Miami hopes, in the near future, to be treating 3000 tons daily.

Calumet & Hecla consolidation is not yet off the rocks. The latest obstacle is a temporary injunction against the consolidation granted by a County Circuit Court in favour of minority stockholders of the Osceola company, on the ground that the State statutes forbid the formation of a merger involving capital in excess of $10,000,000. Seven other copper companies, and a decided majority of the Osceola company, had already voted in favour of the proposed consolidation. The dissentient minority is therefore a small one.

Governmental restraint of the big corporations is fast becoming a settled policy, and it is none too soon. Already the Standard Oil Co. has promised to disband into its 34 constituent elements by December 1 of this year. The Tobacco Trust is expected to follow suit, as a result of its trial before the Supreme Court. Although there is no organized wire trust, a large number of manufacturers of steel wire and wire products were brought to court, individually, within the past month, and were fined $1000 each for conspiracy to monopolize. Action has been begun against the Lehigh Valley Railroad Co. to compel it to dissociate itself from the Lehigh Valley Coal Co. in compliance with the Hepburn law forbidding transportation companies to own stock in coal mines. The Lehigh Valley is only one of many railroads in Pennsylvania under suspicion in this regard. The activities of the Sugar Trust and of the Steel Trust are now under investigation by Congress, and the Lumber Trust, the Paper Trust and the 'Money' Trust have been mentioned as appropriate candidates for inquisition. While all this official interference with business matters is highly distasteful in a democratic country, as savouring too strongly of Socialism, still it seems to be the only way by which, under our form of government, the humble consumer of Trust products can protect himself. The Trusts have been permitted to grow to their present appalling proportions partly through lax enforcement of the laws controlling them, but principally because they have been protected from foreign competition, and they have only to thank their own highhandedness and disregard of business morality if the people are now turning against them. As to the Steel Trust, however, this complication arises: The U. S. Steel Corporation, by virtue of its centralized ownership of iron mines, coal mines, limestone quarries, coke ovens, blast furnaces, steel mills, and railroads, can produce steel products for several dollars per ton less than the independent steel manufacturers, in spite of its much heavier interest charges. If, then, it were to cut prices to yield what others would consider a satisfactory profit, the independent concerns would have to go out of business forthwith. It is not always that magnificent profits go hand in hand with philanthropy.

Miami, Arizona.

The Chino Copper Mine, New Mexico.

TWO GREAT LOW-GRADE COPPER MINES.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

July 1911.	June 1911.	July 1910.
£56. 15s. 6d.	£56. 9s. 10d.	£54. 5s. 6d.

It is not too much to say that consumption on this side of the Atlantic is phenomenal and every branch of the copper trade is enjoying the benefit of enormous demand and cheap prices. The one fear in the minds of the speculative public is that such an increasing absorption of the metal here cannot continue amid the unrest in labour circles, so that unless American trade expands further improvement is barred. The June American Producers figures were not received with favour by the market for this reason, and their publication was followed by the liquidation of some bull accounts and by some bear selling, a movement which continued throughout the month and brought prices down gradually to £56. 6s. 3d. cash and £56. 18s. 9d. 3 months. No pronounced weakness has been shown, mainly on account of the firm attitude of the leading American producers who appear to be once more accumulating stocks. The crop situation gives cause for hopeful views of the future, but the position is much obscured by the uncertainties of a tariff-revision campaign and the government prosecutions.

TIN.

Average prices of cash tin:

July 1911.	June 1911.	July 1910.
£193. 2s. 0d.	£207. 7s. 9d.	£149. 2s. 1d.

Except for the customary preparations in anticipation of the Banka sale late in the month, the market was left without any marked manipulation either by the syndicate or its opponents. Business consequently has been restricted, fluctuations have become narrower, and prices depressed. At one time the market became almost demoralized under pressure of sales by holders of near dates, and prices declined to £188. 10s. cash and £182 forward. At this point, however, the syndicate lent support, and a rally quickly followed to £192. 10s. cash and £185. 10s. forward. Violent fluctuations succeeded and the tendency became sensitive. At the Banka sale 2478 tons was sold at an average of £189. The market leaders had prepared themselves for this by freely selling cash tin and buying 3 months tin, whereby the backwardation was reduced at one time to £2.

The consumers' demand is excellent and they have bought freely as prices receded. The Americans, who have been withholding orders, are now taking a renewed interest, and substantial transactions in the East at high prices are believed to be for their account. Tinplate makers are working at pressure and new works are contemplated in South Wales.

LEAD.

Average prices of soft foreign lead:

July 1911.	July 1911.	July 1910.
£13. 10s. 11d.	£13. 5s. 5d.	£12. 11s. 8d.

Prices advanced substantially toward the end of the month. In the earlier part supplies came along in such volume as to disguise the strong position of the metal and so kept prices from rising. It has been suddenly realized that supplies in all parts of the world are exhausted and an increase in output impossible. Buyers have been quick to appreciate the altered position and are buying ahead to an extent to which the market has not been accustomed for years.

SPELTER.

Average prices of good ordinary brands:

July 1911.	June 1911.	July 1910.
£24. 13s. 10d.	£24. 9s. 7d.	£22. 5s. 6d.

The scarcity of this metal is causing great concern to the English galvanizers. For an advance in price they are prepared, but the limited quantities doled out by the Convention to the English market renders it impossible to feel secure about procuring their raw material. Much indignation is being expressed by the trade at the action of the producers in cutting off supplies. Proposals have even been projected by prominent users to erect works near Liverpool and produce their own spelter.

OTHER METALS AND MINERALS.

Prices quoted on August 10:

SILVER.—24¼d. per oz.

PLATINUM.—172s. 6d. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£61 per ton.

NICKEL.—£169 per ton.

COBALT.—9s. 9d. per lb.

ANTIMONY.—£27 per ton.

QUICKSILVER.—£9 per flask of 75 lb.

MANGANESE ORE.—9d. to 9½d. per unit (1%).

IRON ORE.—Cumberland hematite 19s. 6d. per ton at mine. Spanish 19s. delivered.

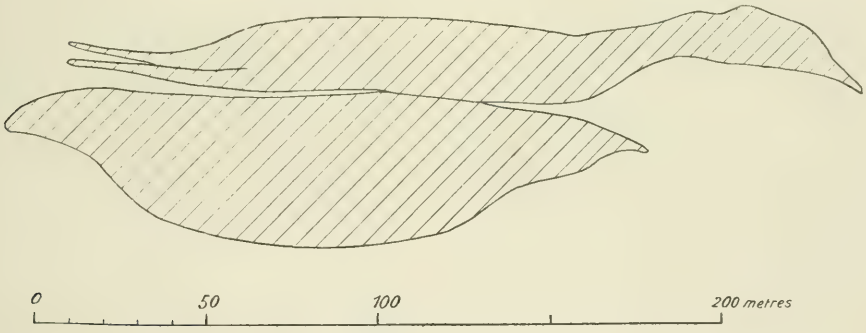
PIG IRON.—Cleveland 47s. per ton. Hematite 62s. per ton.

WOLFRAM ORE—31s. per unit (1%).

THE PYRITES DEPOSITS OF HUELVA

By H. F. COLLINS.

MUCH has been written in regard to the pyrites masses of the province of Huelva, Spain, their mode of occurrence, origin, and the secondary enrichments to which they have been subjected, but comparatively little in regard to their mineralogical composition. In general terms it is matter of common knowledge that these deposits are interstratified with the schist and slate, or occur at the contact between these rocks and acid or basic eruptives, that they are irregularly lenticular in form, and dip at high angles together with the rocks themselves, and that they have been formed chiefly by replacements of crushed rock along shear-zones.



PLAN OF OREBODIES AT HUELVA.

A study of the conditions that have governed the distribution of the copper and other constituents throughout the masses has been rendered difficult by the fact that the deposits which have naturally attracted most attention are those which, being of the largest size, are of the greatest commercial importance, namely Rio Tinto and Tharsis. These, however, are not typical but abnormal, and their relatively enormous size militates against a clear idea of their structure. The larger deposits are usually more frankly lenticular in form, and less resemble ordinary lodes than the smaller ones, many of which present the characters of a series of small lenses placed *en echelon* along the line of an irregular shear-zone, while others exhibit a proportion between length and width, likening them to ordinary wide lodes, for example, 1600 ft. long by 15 to 100 ft. wide; in another case 1000 ft. long by 6 to 50 ft. wide.

One of the greatest errors in the popular estimate of these pyritic masses relates to their supposed uniformity in composition, which in many cases disappears upon close examination. It is true that each individual mine has its current contracts for the supply of a given grade of ore, and that the cargoes shipped in fulfilment of those contracts vary in composition within narrow limits, but uniformity in the ultimate chemical composition of large cargoes is in a number of the mines secured only by careful mixing of different classes of ore that differ considerably in composition. Thus, in the case of shipments averaging, for instance, 2½% copper and 47% sulphur, an average may be obtained by mixing ore from one stope carrying 3½% copper and 44% sulphur with ore from another containing only 1½% copper and 50% sulphur. Similarly, in the case of ore supplied according to another current contract, cargoes that average with considerable uniformity 4% copper and 41% sulphur are secured by mixing silicious ores containing 5 to 6% copper and 32 to 38% sulphur with comparatively clean pyrite containing 2 to 3% copper and 44 to 47% sulphur.

In the orebodies themselves great variations in composition are noticeable. Generally speaking, the largest masses are the most uniform in composition, but even in the largest of all the variations in composition are great, and an enormous number of small samples must be taken over a large number of faces well distributed over the whole area of a given level in order to get any reliable idea of the average value of the ore extractable from that floor. For the sake of economy

this is commonly done by putting in small blasts and blowing down a few hundredweight at a large number of points evenly distributed over the whole area after the mass has been blocked out by levels and cross-cuts; and although this method is inferior to that of sample cuts at regular distances, and is liable to give high results, in practice the error is found to be small, and the method is, of course, much cheaper and less laborious than that of cuts. A good general idea of the value of an orebody that has not been developed by cross-cuts can be obtained by putting in a series of diamond drill-holes transversely across the mass to the walls at regular distances along a main level, but the samples, being small, are liable to be unduly influenced by small patches or veinlets of rich ore.

In any case, it is found that, on a given horizon, samples taken within a comparatively short distance of each other may vary, for instance, between the limits of 0·7% and 4% copper, and the distribution of the rich and poor patches is usually erratic.

It will generally be found, however, that zones or belts of richer or of poorer ore can be traced running parallel to the walls, and often these zones are well defined; so that in a large number of cases, perhaps a majority, it may be said that on a given level the ore near the hanging wall, for instance, is richer in copper and poorer in sulphur than that on the foot-wall side, or *vice versa*. In other cases, no such rule can be traced, and the distribution of the rich and poor ores appears to be completely irregular. Frequently the dividing line between two classes of ore in the same mass is clear and sharp, and sometimes it is marked by a parting of slate of varying thickness. This may, and probably does, indicate in some cases that the ore was not found simultaneously along the two sides of the parting, but successively. Sometimes the parting is not only continuous throughout the whole length of the mass, but becomes a fairly thick wedge of slate, as shown in the illustration. In such a case the inference may be drawn that the ore was formed in two successive parallel and over-lapping lenses along the same broad shear-zone; and since these pyritic lenses vary in width in a vertical plane quite as much as in a horizontal, one of the lenses in the over-lapping portion is likely to dwindle in depth, while the other persists and perhaps even becomes wider.

More especially in the smaller lodes, a banded structure is noticeable, either throughout the whole orebody or in that part of it near one or other of the walls — doubtless a relic of the original stratification of the country-rock. Such a banded structure is so well marked in one of the smallest of the pyritic lode-lenses as to leave no doubt of the gradual replacement of slate by pyrite. The hanging-wall portion of the lode in question varies in the lenticular swelling from 3 to 15 ft. in width; it is composed of compact cupriferous pyrite varying from 43 to 47% in sulphur and 2 to 5% in copper, the higher percentage of copper accompanying the smaller width, and *vice versa*. The footwall portion of the lode, from 3 to 10 ft. wide, is composed of alternate narrow bands of the same class of compact cupreous pyrite varying in width from $\frac{1}{16}$ inch up to 6 inches, and of generally broader bands of crushed and silicified slate highly impregnated with small crystals of iron pyrite, in proportions varying from 30 up to 60% pyrite. This impregnated slate contains from $\frac{1}{2}$ to 1% of copper, not however in the crystals of pyrite, but in the form of a fine dissemination through the slate itself; the division between the pyritic slate and the ordinary schist country rock is sharp, and often, though not invariably, marked by a clay selvage.

When a banded or laminated structure is at all marked in a part of the lode it will usually be found that not only the copper but also the foreign matters range themselves along the bands or laminæ. The foreign substance of most common occurrence is, of course, quartz, but blende and galena are also quite common, and frequently intimately mixed. The resulting banded 'complex' mineral may contain, as at Sotiel and Poderosa, for instance, only 2% Pb and 4% Zn, or it may contain, as at Monte Romero, up to 15% Pb and 30% Zn. Whole cargoes have been shipped from this latter mine containing as much as 11% Pb and 28% Zn, besides $1\frac{1}{2}$% copper and 5 oz. silver per ton, the copper varying at the same time from 4 to $4\frac{1}{2}$% down to $1\frac{1}{2}$%, usually in inverse proportion to the zinc and lead.

Intimate mixtures are found of chalcopyrite and iron pyrite; these may be regarded as fine disseminations of the former in a solid solution of the latter, or rather perhaps, seeing that in most cases the iron pyrite crystallized first, as a spongy aggregate or network of fine crystals of pyrite surrounded by a greater or less quantity of a solid solution of pyrite and chalcopyrite. I have specimens of ore from a small lode running from four inches up to a foot or fifteen inches wide,

which consists of such a solid solution or intimate mixture of pyrite and chalcopyrite, not resolvable into its constituents except under a high power, the average value of which lies between 17 and 21% copper. Imbedded in it, like shot, are small crystals of pyrite, which apparently crystallized first from the 'solid solution' of the mixture. The observed variations in the value of the 'primary ores' of different orebodies can thus be explained on the supposition that they depend upon the relative proportions of crystals of pyrite and of residual or interstitial solid solution of pyrite in chalcopyrite composing the aggregate. The generally greater hardness of the poorer ores may also be due to the same cause.

Besides the original copper contents of the primary ore, however, two entirely different kinds of secondary enrichment are to be noted. The first has been generally recognized, because most obvious. It consists in the deposition in those portions of the orebodies that are nearest to the present surface, and in the forms of chalcocite and chalcopyrite, of a large part of the copper contents of the overlying portions of the orebodies that have been removed by denudation; and in the subsequent alteration of the chalcopyrite so deposited as well as of that originally existing in the ore, to chalcocite. This process has taken place almost invariably in all kinds of copper sulphide ore deposits, and is that commonly known as 'secondary' or perhaps more properly as 'surface enrichment.' Besides this, however, there appears to have been another kind of enrichment of these pyritic masses: this is secondary in the sense of taking place subsequently to the formation of the ore, but has nothing to do with surface agencies and may therefore be called 'deep enrichment.' It is due to the introduction into the pyrite of chalcopyrite, which takes the form of myriads of irregular interlacing strings from $\frac{1}{500}$th up to an inch or more in thickness, swelling into bunches here and there, and of isolated patches that may run up to several pounds in weight of almost pure chalcopyrite.

Entrance of this secondary chalcopyrite has been facilitated by the crushing and fissuring of the pyritic masses by repeated complex earth movements subsequent to their formation, in some cases producing a brecciated structure, readily visible in parts where there has been also considerable infiltration of secondary quartz.

The secondary chalcopyrite is generally associated with quartz, sometimes however with calcite or dolomite, large numbers of veinlets of which are seen in places, occasionally running up to 3 or 4 inches thick. More rarely barite and gypsum are found associated with the chalcopyrite.

In almost all the pyritic masses, even those the average copper content of which is lowest, a small proportion of rich chalcopyrite ore is picked out for separate treatment or shipment, and this holds good even in the case of lodes like that of Perrunal, the average amount of copper in which is so low that the vast bulk of the ore is sold for its sulphur value only. In similar fashion to the chalcopyrite, bunches and veinlets of tetrahedrite are found in some of the masses, and this also is often picked out for separate shipment to smelting works, since it is apt to be rich in silver, assays occasionally running as high as 2% of silver or over 600 oz. per ton.

The close association of the 'deep' chalcopyrite enrichment with calcite and dolomite, as well as quartz, coupled with the fact that these minerals are often found in greatest abundance in systems of veinlets running transversely to the strike of the pyritic masses, and with the further fact that the ore-masses in which this chalcopyrite enrichment is most prominent are those that are in close association with, or in the immediate neighbourhood of the dikes already mentioned as running approximately parallel to the stratification of the country and to the lodes, indicates in my opinion that the secondary chalcopyrite is probably coeval with the last great series of tectonic movements in this region, namely that which gave rise to the intrusion of the later series of basic dikes, these being certainly of post-Triassic and most probably of Tertiary age. Upon this theory the source of the copper forming this deep secondary enrichment is to be found in the same deep-seated source that furnished the copper in the primary ore; only that at the much later date of this secondary mineralization the preponderance of iron pyrite had disappeared, and the ascending solutions, which were probably highly alkaline, now brought only chalcopyrite, blende, galena, and quartz, with a comparatively small proportion of pyrite. The old channels or vents that served for the production of the pyritic masses having been to a considerable extent sealed from below, the solutions came up in some cases along one of the walls, in others through new lines of weakness or fault-planes forming quartz-chalcopyrite lodes, like the Ratera, near Val-

verde, and those of the Campo Frio series, and in still other cases with the basic later eruptive intrusions themselves, from which their mineral contents were distributed into the crushed and fissured pyrite, forming the series of interlacing strings with compact bunches of chalcopyrite, which are, although unevenly, so widely distributed throughout the pyritic masses. When the ore near one wall of a pyrites lode is richer in copper than that near the other wall, it is almost invariably the case that the rich side is that nearest the eruptive dike. This association of enriched portions of the lode with proximity to eruptives is well exemplified at Cueva de la Mora, San Platon, Esperanza, and various other mines. In this connection it may be remarked that besides chalcopyrite, native copper has been found finely disseminated throughout compact diorite on the footwall side of a small pyrite lode, and 60 ft. away from it. There is in this case no evidence of transverse jointing such as could have explained transference of the copper from the lode-channel into the diorite, and it is my belief that the copper (which is evenly disseminated through a considerable extent of the diorite as shown by cross-cuts 60 ft. apart, and in such proportion that the whole rock assays about 0·6% copper) is an original constituent of the intrusive rock, and it is from the latter that 'deep secondary enrichment' of the pyrite has been effected.

Besides blende and galena, already mentioned as occurring with the primary ore, and tetrahedrite which is probably, and bornite certainly, of secondary origin, other comparatively rare minerals are occasionally found. Bournonite, smaltite and native bismuth, for instance, have been found in the comparatively small but exceptionally rich Monte Romero lode, all however in cross-joints, so that they are probably of secondary origin. Smaltite has also been found on the hanging wall of the Cueva de la Mora lode, in a small veinlet parallel to the main mass. In the zone of secondary enrichment, besides chalcocite and native copper, the latter in masses up to 5 lb. weight, fine specimens of cuprite, malachite and azurite are occasionally found, and in one case a 16-ton lot of mixed carbonate ores was shipped by me from a pocket just under the outcrop of a small pyritic lode, that contained 26% copper, wholly as carbonate and oxide, with barely a trace of sulphur.

In the zone of secondary enrichment, besides melanterite and chalcanthite (the former often containing up to 9 or 10% copper), other sulphates are sometimes found, including epsomite, roemerite (found by me at Sotiel), bloedite, and recently at the Concepcion mine a most interesting group of associated sulphates, including copiapite, coquimbite, roemerite, and at least two other species as yet undetermined.

The following is a complete list, so far as known to me, of the mineral species undoubtedly found up to date in Spanish pyritic masses, without taking into account alteration products of enclosed or associated wall-rock such as sericite, talc, and so forth.

Deep-seated Zone	*Surface-enrichment Zone*
Pyrite	Native Copper
Chalcopyrite	Native Silver
Chalcocite	Native Sulphur
Blende	Claudetite
Galena	Covellite
Tetrahedrite	Cuprite
Bournonite	Malachite
Smaltite	Azurite
Native Bismuth	Brochantite
Pyrrhotite	Bornite
Magnetite	Erythrite
Vivianite	Cerussite
Quartz	Anglesite
Calcite	Limonite
Dolomite	Hematite
Barite	Chalcanthite
Gypsum	Melanterite
	Bloedite
	Epsomite
	Coquimbite
	Copiapite
	Roemerite
	besides two other undetermined sulphates

It will be understood that in the zone of surface enrichment are found the minerals of the deep-seated zone in addition to those above-mentioned as peculiar to the former zone. Chalcocite, although commonest in the zone of surface enrichment, has been placed among the minerals of the deep-seated zone because occasionally found at considerable depths, where, however, like the chalcopyrite itself, it has been obviously introduced after the formation of the pyrites masses.

Calumet & Hecla.—This company has made a new departure by issuing details of production and cost. During 1910, 2,795,514 tons of ore was treated, yielding 72,059,545 lb. of copper. The cost per pound was 8·96c. and the average price obtained 13·2c.

THE FINANCE OF A MINE. III.

By M. H. BURNHAM.

AS mentioned before, the geographical position of most mining enterprises with reference to centres of capital tends to thrust a special duty upon the engineer ; hence the summation of the individual factors influencing the vending interests and terms of payment should normally fall to him if purchase be regarded from an economic point of view. From time immemorial sale and purchase have implied that the first price asked is based on the expectation of a counter offer, and subsequent reduction, while the very nature of economics calls for an effort at diminution of risk, often best accomplished through deferring cash payments by means of shares or debentures.

Now, one may frankly ask the engineering world how completely has its training either at school or in ordinary practice equipped it for meeting this demand upon it ; how many have kept sight of even the economics of industry in the maze of purely technical advance; and still again, how many have, though keeping the bases of industry before them, acquired the gentle art of playing speculation as a sweet flageolet wherewith to win reluctant vendors to reason ? And yet these are modern demands requiring not only an understanding of the economics of industry, but a sound grasp of the economics of finance as well.

The two phases of development represented financially by the Syndicate and Company stages, differ principally, in that the former is not expected to have ore 'blocked out' and that vendors receive only shares or other interest in the property, while the latter stage usually implies, in sound practice, at least, that cash outlay on purchase and plant be represented by the present value of the assured or blocked ore.

In the ordinary course of mining operations the successive stages may be roughly summarized as follows, though the different degrees of development in parts of a developed mine may involve problems peculiar to an earlier stage. These may be said to be:

(1) The period of purely geological surmise ;
(2) The period of definite quantities and values, as well as of surmise.

If I may be allowed to recapitulate, the first article of this series dealt with the fundamental bases of valuation, namely, that the greater the risk, the greater the rate of interest required. The second article elaborated the first and sought to show that this simple business concept, if expanded, not only offers a solution of the problem of valuing blocks of ore in different stages of development, but makes a reserve of the ore below the deepest level, at the same time fixing a lower limit to these blocks ; otherwise, it determines the shoot-extension.

Finance, at least such phases of it as legitimately concern the engineer, calls for a careful consideration of the above stages, and of the first—that of geological surmise—we may say without much fear of contradiction : 'Unless profitable ore be found on the surface, sound valuation does not permit of cash expenditure save on exploratory work.' Manifestly this implies the belief that the orebodies will repay the outlay necessary not only to exploration, but to development and plant wherewith to realize the values contained ; in other words, even the stage of geological surmise implies a postulate of dimension and value. The first stage is more especially noticeable when dealing with copper outcrops, where profitable ore is rare at the surface.

On the other hand, the second article indicates that in the case of, say, a gold prospect stripped along the outcrop and sampled, one may be justified in paying the vendors in cash, the amount of which (see Formula X) would depend upon the profit per ton, length and thickness of shoot, and capacity of plant, the value of which must be redeemed, and other factors.

It follows then that payment for property is not a question of development but of data available, and it is conceivable that a well-sampled outcrop with favourable geological conditions may be given the same value as the deepest level in a mine.

IF IT BE ADMITTED THAT EXPENDITURE ON GEOLOGICAL SURMISE, UNSUPPORTED BY ASSAY-VALUES, OTHER THAN THAT ON EXPLORATION, BE UNSOUND, THEN A PURCHASE INVOLVING PAYMENT FOR ORE BELOW THAT ALLOWABLE AS DETERMINED BY THE ASSAY-VALUES, IS ALSO UNSOUND.

Stripped of technicality, one may say that where outlay is made independent of values, the investors are 'backing' the geologist's surmise, and while they might cheerfully support a specialist of the first rank, it is doubtful if they themselves would counsel or permit payment to vendors before ore was found. Fur-

thermore, all of these men would have at least some idea of the economic magnitude of the orebody expected, whether it be a 'saddle' at Bendigo or a zone of secondary enrichment below a brecciated gozzan.

If the foregoing be accepted, then the expenditure on exploration per unit of orebody expected should be a measure in current practice. As it would seem to be impracticable to predict the depth allowable unsampled or 'surmised' ore, the unit used will be the sovereigns of profit in a horizontal slice through the ore-shoot, one foot in depth. This is a basic feature common to both stages and will be called the 'economic shoot';* it serves as an index and means of classifying the possibilities of each and should be clear from the following figure, which reproduces a common type of undeveloped prospect, having in general an appearance in plan like that shown in (*a*) of Fig. 4; (*b*) gives a longitudinal section of the same when developed to, say, the Company stage.

It would seem that the most casual speculative thought would go a step beyond the idea conveyed by the ordinary word 'shoot,' insomuch as the boundaries are necessarily economic. The childish drivel of concise terminology prevalent among those who pass for learned, or pose as practical, is especially exasperating when ore-shoots are being considered, and one wonders that mining engineers are allowed even the degree of toleration accorded them by intelligent financiers. What the latter require is a practical foundation upon which to base their calculations: some sound standard whereby to compare the *probable* magnitude of the enterprise with others of similar nature, even if no certainty exist.

Surely the most obdurate must admit that a term, which in its very essence is economic, yet which conveys no definite meaning, suggests either stupidity or intention to mislead. Surely, when a 'shoot' may be, say, 1500 ft. long, and yet be either 6 inches or 60 feet thick, when it may yield 6 pence or 60 sovereigns per ton in profit, the use of mere shoot-length as a measure of magnitude is ineffective, to say the least. What our more reputable financial friends demand is the economic shoot, which for each foot worked along the major axis yields not so much ore but so much *profit*: an economic slice, as it were, one foot in depth. The financier would then be in a position to compare those offered by different projects; to gauge probable future magnitudes and accordingly shape the business programme.

This estimated dimension of the economic shoot applies not only to the prospect, but to the developed mine; it is often as applicable to iron as to gold; to china clay as to copper; to a bed of banket as to the channel of an ancient river; whether the extension be horizontal, vertical, or inclined.

The one point of difference to be made between prospects and mines, between the Syndicate and Company stages, is that the latter usually calls for definite assets or 'blocked ore,' and, if well financed, the economic shoot with its possibilities thrown in.

Prospects may be conveniently divided into two types, depending as in all such classification upon the validity of the data offered. These are:

(*a*) The geological surmise type, as, for instance, petroleum prospects in new fields;

(*b*) Proved shoot type; with ore to be sampled on one side only as, for instance, an ancient working in Rhodesia accessible to sampling; or a well exposed outcrop.

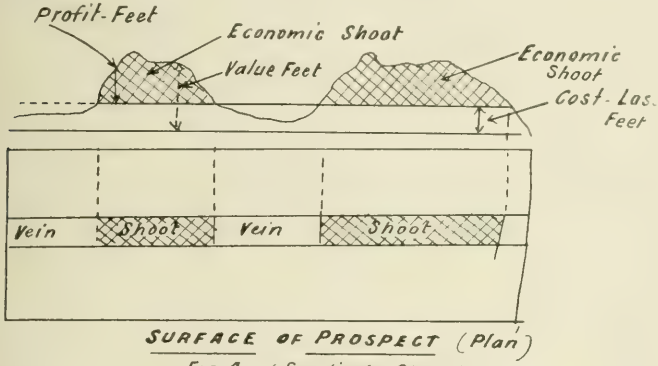
In the case of (*a*) it may be stated that only upon rare occasions could it be considered sound practice to lay out capital save for development work, while, as before mentioned in dealing with (*b*), if local geological data were favourable a payment to vendors might be made in accordance with the principles enunciated in the preceding article.

From the foregoing it will appear that finance during both the Syndicate and Company stages is vitally concerned with the magnitude of the economic shoot, while the ratio of that portion of the paid-up capital of the company not represented by the present value of the proved ore, to the units in the economic shoot, furnishes a means of comparing valuations.

It will have been noted that 'probability' as a term defining orebodies has been eliminated, it having been incorporated in the risk-rate principle. There remains, however, 'possibility,' which refers to the economic shoot below the ore allowed for. For example: when considering two mines of different economic-shoot proportions, the possibilities of securing the always hoped-for bonanza in the ground beyond that for which payment may be made, might be said to be greater with the bigger economic shoot, as a single foot in depth would yield a greater profit in the case

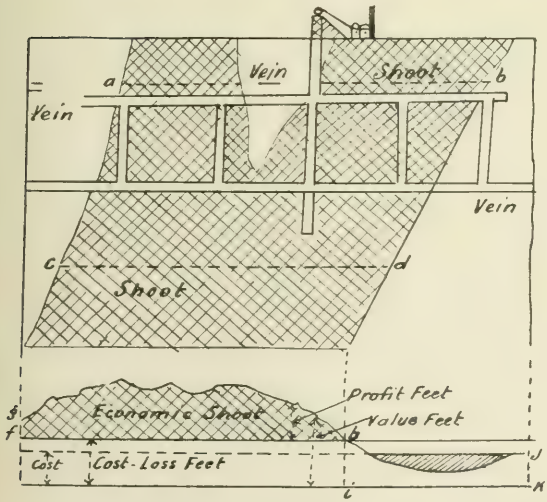
* While any 'shoot' in a mine is essentially determined by 'economic' conditions, this use of the term expresses magnitude of profit as distinct from physical dimensions.

of the bigger shoot. For instance: in Fig. 4, though we may pay for the ore to the point *c d*, the ore beyond is 'possible' only. In other words, we pay for probability but hope for possibility, and one measure of financial ability is the price paid for a unit of this comforting sensation, as discussed later.



SURFACE OF PROSPECT (Plan)

FIG 4 a (Syndicate Stage)



Area. e-f-g-h-i-e = Gross Value Shoot

" f-g-h-f = Economic Shoot

FIG 4 b. (Company Stage) Longitudinal Section

For the purposes of illustration cost-losses and shoot-thickness are taken as uniform.

The foregoing may be said to bear particularly upon what is permissible, and while ideas will vary somewhat both as to the risk-rate applicable and as to the dimensions of the standard block, once these are determined there would seem to be small room for great variations of opinion as to what constitutes sound valuation.

It is hoped that due weight has been given to the word 'permissible,' for though it should not be necessary, it is as well perhaps to state that practically the whole of the discussion of economics and the risk-rate principle has been with a view to establishing a standard not for what may be but what should be invested in a property. That is, the engineer too often neglects the human element, while the financier is governed by it. The tendency of the former is to base his offer upon the value of the property, while the financier's consideration is the monetary needs of the vendor. This illustrates the difference in psychology between the financier and engineer, between negotiation and valuation; between human nature and formula.

Evidently, while the measure of the reporting engineer *per se* is his ability comprehensively to express technical facts and postulates in economic units, that of the financier is his practice with reference to outlay, which should be made in such a manner as to incur the least risk or to invest the least capital incidental to securing a given profit.

Where the total present value is paid to the vendors of a mine, it may be safely said that either the mine was over-valued by the engineer, or the financiers neglected the very elements of their work, which are intelligent negotiation and construction after valuation. It must be confessed that even the degree of self-appreciation common amongst engineers cannot obscure the fact that a little deft manipulation of the personal factors governing the vending interests will often secure conditions that make ordinary technical economies seem paltry; this is too often entirely overlooked. As before mentioned, an opinion as to the value of shares, large blocks of which are often offered for underwriting, is a constant demand and while the basement complex of personality which affects the market and division of profits from such sources of profit, concern the financier only, the economics of the enterprise as well as the training,

experience, and good name of the engineers upon whose recommendation flotations are made, concern the consulting engineer. The latter has then to consider carefully not only the company construction and its significance, the technical reports and data, but the reputed ethical standards and responsibility of the valuing engineer.

From the foregoing it follows that not only the relation of the proved orebodies to the purchase price plus equipment outlay must be considered, but also the payment made for the possibility of the economic shoot, though the latter can only be ascertained by combining a study of company construction and technical reports.

mentioned. In some cases costs and losses have not been given in the official statements and these have been approximated, as, for example, in the case of the Prestea.

While Table IV seeks to show the significance of the magnitude of the economic shoot as a measure of finance, a later article will deal with the relative promise of great and small mines. Columns 3, 4, and 5 are the proved shoot-lengths, mean thicknesses, and profit per ton as given in published plans or statements only, that is, they are not private estimates. Column 6 is the keynote of the Table, and, as before explained, is the measure of the ordinary mine, apart from the reserves, being the profit in sovereigns to be

TABLE III.—THE ECONOMIC SHOOT.

Mine.	Metal	Length of Shoot* Ft.	Average width* Ft.	Gross value† per ton £	Mean sectional value-feet*†	Combination factor* (loss and cost)†	Mean sectional profit-feet† £	Sovereign shoot-feet‡
Pilares (Mexico)	Copper	1700	600	8·10	4860	6·1	1200	27,000
Mount Morgan (Queensland)	Gold-Copper	800	500	13·70	6850	8·87	2330	25,000
Santa Gertrudis (Mexico)	Silver	1500	15·5	23·20	360	10·8	193	4,000
Mother Lode (British Columbia)	Gold	1200	150	6·70	1012	5·7	150	2,500
Camp Bird (Colorado)	Gold	1700	+	31·50	126	15·4	64	1,500

* Approximations, for illustration only. † Values in U.S. dollars.
‡ 15 cubic feet per ton (approximate).

Table III gives a list of five well known companies with the approximate magnitude of their economic shoot expressed in sovereign-feet.

The different kind of shares commonly issued will be discussed in detail in a later article, but Table IV may serve to emphasize the significance of the economic shoot as expressed in terms of company-capital and market-value. The present value of the reserves, that is, the deferrence factor, is neglected for simplicity's sake, and round numbers only are given.

To those interested in the economics of finance, Table IV should be of interest, though through lack of the latest facts the figures given must not be read as being exact, the idea being illustration from current practice, and not information concerning the mines

expected from each foot in depth as the proved ore-shoots are exhausted. It is held that this is a far more comprehensive measure of the probable future magnitude than the ore blocked out, as a small shoot may have been worked systematically and show large reserves, while a large one of equal profit per ton may have no reserves above the lowest level. In this figure of economic shoot are condensed the work and innumerable technical calculations incidental to sampling, assaying, losses, costs of transport, taxes, duties, refining charges, and a host of others, the enumeration of which obscures, often designedly, the real issue, which is the estimated future magnitude of the mine. Evidently costs and losses bear a relation to capital outlay on plant, hence such estimates are also incorporated in the economic shoot. The last word is used advisedly,

Table IV.—Valuation and Finance of Possibilities.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Name of Mine	Metal	Aggregate length proved ore-shoot Ft.	Thickness in ore-shoot Ft.	Estimate profit per ton lowest level £	Approx. number of sovereign shoot-feet	Approx. present profit in reserves above lowest level. £	Issued capital of company £	Capitalization p. shoot-foot ‡ £	Capital less Reserves £	Engineers Valuation of Possibilities. Rate per shoot-foot ‡ £	Market selling price of Co. (approx) £	Market selling price less value reserves (present approx)	Finance of Possibilities. Price paid per sovereign-shoot-foot or depth to recover capital
(a) Abosso (West Africa)	Gold	3200	4·0	0·50	500	125,000	400,000	800	275,000	800§	550,000	425,000	850
(b) Prestea A. (West Africa)	Gold	4000	7·0	0·85	2000	500,000	850,000	425	350,000	425§	1,275,000	775,000	390
(c) Gt. Boulder Proprietary (W. Australia)	Gold	1500	7·5	1·75	1500	1,287,000	175,000	117	—	117§	1,750,000	463,000	310
(d) Santa Gertrudis (Mexico)	Silver	1500	15·5	2·50	4000	500,000 ¦ 110,000 ¦	1,275,000	(300)†	775,000	194	1,275,000	775,000	194
(e) Redjang Lebong (Sumatra)	Gold	900	40·0	1·90	5500	570,000	200,000	37	90,000 ¦	17	1,600,000	1,030,000	187
(f) Alaska Mexican (United States)	Gold	1000	300'	0·36	8500	375,000	180,000	21	—	21§	540,000	165,000	20
(g) Alaska United (United States)	Gold	800 350	300' 300'	0·34 0·30	9000	310,000	180,000	20		20§	540,000	230,000	26
(h) St. John del Rey (Brazil)	Gold	800	17'	·64	700	724,000	656,000	(940)			525,000	—	—

* Column 11 is also only of interest at the time of flotation, but is then an accurate measure of both engineer and financier.
† Column 9 is worthless, and only of interest as no reserves at the time of flotation.
‡ This applies to time of flotation, that is only.
§ In default of relevant data this assumes no reserves at time of flotation.

for though the boundaries of any shoot are essentially variables as determined by costs and losses, hence economic, the ordinary idea of shoot magnitude as expressed by area (length and thickness) does not express the profit per ton; hence is entirely misleading.

As the shoot bears on the future of the mine and not on the proved reserves, the lowest full-shoot level is where one looks for data, and while the economic shoot at one level will vary from point to point, it remains an approximate measure of what one may expect in depth, assuming no vitiating geological features like the danger zone so common at about the same level in some silver camps where zinc ores begin to appear. Occasionally, of course, an expanding or contracting rake of shoot, as indicated by assay-plans, might be considered, but usually this would be considered when dealing with reserves lying below the deepest level.

Column 7, giving the net value of the reserves, calls for little comment beyond suggesting that the validity of the estimates depends so much upon the size of the blocks and methods of sampling and appraisal, that one must take those of Table IV as they stand. In reality, their actual value is inadequately expressed by the above figures, inasmuch as only their present values should be considered, by allowing interest at a rate commensurate with the risk incidental to each until they may be realized upon. For the purpose, however, of comparing the 'finance of possibilities,' the above figures will answer.

According to my own theorem and formulas, as set out in the first two articles, the reserve should include ore below the deepest level to a certain point to be determined by simple calculation. As, however, only those familiar with the local geology may say if such an estimate be permissible, those reserves lying above the lowest level are alone considered in the Table.

Column 7 is of great importance as expressing definitely the valuation (when shares are issued at par) of the mine as estimated by the financiers and to which, it is contended by me, the engineer is sponsor and participant, more particularly with regard to the first flotation. This figure, coupled with the kind of shares issued (deferred, debentures, ordinary, etc.) is not only a measure of the engineer, moral and technical, but frequently a sure guide, if full detail be published, to the business acumen, or the reverse, of the financiers responsible.

Column 9, or the ratio of the capital of the company to the number of sovereigns of profit to be expected from exhausting the shoots to a depth of one foot, may be said to be the payment made per unit of possibility and is essentially the measure of mining finance. To some it will be more convenient to regard it as the number of feet to which the shoots must be exhausted in order to repay the capital of the company (neglecting interest). This is another way of saying that those responsible for the flotation predict that the mine will not be exhausted before a certain depth is reached, for no one can conceive of risking money without believing that he will at least have his capital returned. In plain English, then, capitalization beyond that represented by the present value of the reserves, is equivalent to an estimate of shoot-extension in depth, whether this be on the engineer's advice or not. In comparing new flotations, then, if no ore may be classed as a reserve, this ratio (Column 9) is the key to the economic position, of course, in default of modifying geological data.

Column 10, or the issued capital (at par) less the reserves, is of particular interest only at the time of flotation, for the capital less the net value of the reserves must represent the amount paid for the estimated possibilities of the mine.

Column 11, the rate paid per shoot-foot or the depth to which the shoots must be exhausted in order to repay the nominal issued capital less reserves, is also significant only at the time of flotation. For example: those responsible for the Santa Gertrudis flotation practically state that the mine warrants a payment for shoot-extension to a depth of not less than 194 feet, while the financing of the Redjang Lebong called for 17 ft. only. One would read it that the engineers and financiers of the Redjang Lebong must have looked to dividends and an appreciation of their shares through development of the mine, rather than ask subscribers to gamble that the unproved ore would extend to any depth.

Columns 12, 13, and 14, or the market selling-price of the mine, is affected by too many factors other than dividends, to bear upon those economics of finance with which alone we are dealing. On the other hand, Column 14 is extremely interesting as illustrating what may be called the finesse of finance as distinguished from economics. This subject, however, calls for a subtlety of mind possessed but rarely by engineers, and could be adequately elucidated by only two or three notable exceptions to the rule.

In the interests of legitimate mining one cannot do less than call attention to the sound and honourable valuation which, as indicated by the Table, would seem to be the policy of those directing the Redjang Lebong, the Alaska Mexican and the Alaska United. Those connected with the St. John del Rey company also appear to be governed by the same standards. These cases are of great interest, theoretically, and encouraging to those who follow mining for mining's sake, or who are concerned with the economics of finance.

Recapitulating, we may say as a premise that:

(*r*) Cash expended on an unproved unsampled prospect other than that incidental to exploration is unsound, and

(*s*) The cost of exploration divided by the number of economic-shoot-feet expected is a measure of outlay on possibilities;

(*t*) Ore in a developed mine lying below *that which the engineer is willing to class as a reserve* (*) and pay for, is 'possible' only, hence is of the same nature as the unsampled prospect. Therefore outlay other than for exploration is also unsound;

(*u*) The issued capital of a company (at par) less the value of the reserves divided by the number of units in the economic shoot, is the outlay made per unit of possibility and is a measure of finance valuation.

The last is equivalent to the number of feet in depth necessary to exhaust the mine in order to repay the capital, hence a very fair idea, in default of modifying geological data, of the relative promise of capitalized mines may be had by applying the above (*u*); that *r*, *s*, *t* are not academic postulates finding no expression in current practice is shown by reference to Column 11 where it is seen that the capitalization of the above mentioned three great properties has not allowed for more than 20 ft. of shoot-extension.

*The above table classes as reserves only the ore lying above the deepest level. I hold that in many of the mines cited, an allowance should be made for ore below, as discussed in my second article.

Coal in South Africa.—In his address to the South African Institute of Engineers, R. N. Kotze, Government Inspector, spoke of the future importance of the coal resources of South Africa, and gave it as his opinion that the proved deposits contained 20,000 million tons of available coal.

Kildonan Goldfield.

Paragraphs have been published in the Press recently to the effect that a returned Klondiker is making an examination of the gravel deposits in the Helmsdale and tributary valleys on the east coast of the county of Sutherland, in Scotland. Some notes on this goldfield extracted from Malcolm Maclaren's volume on 'Gold' will be of interest. Tradition has it that gold was discovered as early as the year 1245, but no authentic record is extant of any work being done. In 1840, it is stated, a nugget weighing $1\frac{1}{2}$ oz. was found in the Kildonan stream. A rush was made to the district in 1868 and for a year or so quite 400 men were occupied. During this time a production of gold worth £3000 was reported officially, but as the law imposed a 10% royalty there is good reason to believe that the production was really much greater. A competent authority put the actual figures at £12,000. At about the same time gold-bearing gravel was found about ten miles to the southwest in two streams that run into Loch Brora; the work however interfered so much with sheep-farming that the licenses were suspended in 1870.

The Kildonan district consists of moorland and heather-clad hills, with extensive bogs at the sources of the streams. The valleys are mostly narrow and straight, so that there are few alluvial flats of any notable size. The rocks are granites and metamorphic schists of varying character, and over them are thick deposits of glacial drift which are overlain in turn by peat. The gold is found as small grains in the beds of the streams and in the gravel banks. It is most abundant in the coarse gravel and in the crevices of the upturned edges of the schist, across the strike of which the streams run, but it appears to be also disseminated throughout the drift. The heaviest nugget ever found weighed 2 oz. 17 dwt. The richest deposits so far known were in Gold burn, where several specks may still be obtained from every pan. The source of the gold has not been identified; it is doubtless to be sought in the quartz veins that are found in the schist and in the granite at the contact with the schist. Several such veins are known, but apparently no indication of the presence of gold has been recorded.

Other parts of Scotland have yielded more gold than Kildonan. For instance, during the 16th century extensive alluvial deposits were worked in the Leadhills district situated in the south of Lanarkshire. The original matrix was the quartz veins, several of which have been proved to be auriferous.

MINING IN RHODESIA

By F. P. MENNELL.

IN endeavouring, at the editor's request, to give the readers of *The Mining Magazine* some idea of the present proportions and future prospects of the Rhodesian mining industry, I am confronted by a very real difficulty. Rhodesia is not a country of one district, one mine, or even one metal. Gold ranks easily first in importance at present, but other mineral products are gradually rising into prominence as the country becomes opened up and the cost of working is reduced. Even if attention be confined to gold, it is impossible t to be struck with the widely scattered situations of the principal mines. There is no 'gold-belt' (to use the prevalent local term) that greatly outshines its fellows in importance; indeed, it is rare for a big productive mine to have many near neighbours of much promise. Whether the comparative isolation of the larger orebodies tends to the advantage of the industry, or otherwise, it is hard to say, but it is certain that it has led to a more general exploitation of the territory than would be the case if the future of Rhodesian mining depended on a Rand or a Kalgoorlie. What is, however, more to the point is that this fact renders it difficult to summarize the industry in the course of a brief article. In keeping with their widespread geographical distribution, the mines of Rhodesia vary extremely in geological occurrence and mineralogical characteristics, while their mining methods and metallurgical practice exhibit equal diversity, having borrowed much, sometimes from one centre, and sometimes from another, though not without the addition of features peculiarly their own.

Southern Rhodesia, the territory to which alone the name 'Rhodesia' is popularly applied, is not a definite geological unit: its rocks extend into the surrounding territories in all directions. Yet even the northern Transvaal, with its large areas of precisely similar crystalline schists, invaded in the same way by huge granitic intrusions, is apparently inferior from a mining standpoint, a fact which seems anomalous in view of the widespread distribution of the auriferous and other lodes of Southern Rhodesia itself. The Rhodesian 'gold-belt' rocks, moreover, strongly resemble the Kolar schists in India, as well as those of the metamorphic areas of Western Australia. That they are of Archæan age can scarcely be doubted; indeed in the granitic gneisses with which they are so closely associated it is possible to recognize the equivalent of the Laurentian system of Canada, which have been shown by Adams, as I have endeavoured to demonstrate in Rhodesia, to be intrusive in the crystalline schist which was at one time supposed to overlie them in true stratigraphic sequence. The granite here is not predominantly gneissic in structure, but there is no real reason for considering that there is any definite distinction in age between the different types, especially as they frequently grade into each other. The invaded formations comprise (1) Massive epidiorites, together with more typical hornblende and chlorite schists, (2) a series characterized by the peculiar laminated ferruginous rock known as 'banded ironstone,' often associated with basic igneous intrusions, especially serpentine, (3) a series of grits and conglomerates with intercalated amygdaloids; to which may be added in some localities a succession of limestones. The details of the relationships of these rocks must await the researches of the geological survey recently instituted under the direction of Mr. H. B. Maufe; for a general account of them the reader may be referred to my paper in the Quarterly Journal of the Geological Society for August of last year. All these ancient rocks occupy with the granites the higher parts of the country near the Zambesi-Limpopo watershed, and it is in them that nearly all the gold veins and other mineral lodes are found.

QUARTZ REEFS.—As in most other countries, veins of quartz constitute the main source of the gold. They are most common among the hornblendic rocks and gradually conform to the strike of the enclosing country. They are nevertheless often true 'fissure veins' occurring along planes of faulting, and may cut across the strike of the schist. The length of the orebodies is usually not great, yet in their continuity they are more satisfactory than in the persistence of their gold contents. A length of 500 ft. along the strike is exceptional for a profitable ore-shoot, but among the larger mines the maximum extent is as much as 4500 ft., as the Surprise. The Phœnix shoot averaged 750 ft. in length before the present rich ore was struck. Since then the pay-ore has extended for over 1000 ft. At the Lonely

mine the length of ore is also just about 1000 ft. The average width is rather under 30 inches at the Globe & Phœnix and about 3 ft. at the Lonely. Of course, there are much wider veins, such as the Jessie at Gwanda and the Bell at Sebakwe, but they are much lower in grade than the 33 dwt. ore of the Phœnix or the 20 dwt. of the Lonely. It is a characteristic of these and most other veins in Rhodesia that in the pay-shoot the big widths nearly always coincide with the richest ore. Instances, however, can be cited where the exact reverse is the case, as in the Tuff-nutt at Bembezi.

The country rock shows great diversity of character. It is noticeable nevertheless that most of the leading mines have the common feature of being close to granite contacts, and there can be little doubt that the intrusion of the granite was a determining factor in the formation of a large proportion of the orebodies. This is a much more striking characteristic than the association with basic rocks, on which authorities like Dr. Maclaren have strongly insisted. The following list may be found instructive:

In Epidiorite country: Beatrice, Bucks, Farvic, Joker, Queens.

In Serpentine or its alteration products: Eiffel-Blue, Eileen-Alannah, Lonely, Penhalonga.

In Hornblende-Granulite: Blanket, Jessie, Mont d'Or.

RHODESIA.

In Mica Granulite or Gneiss : Etna, Falcon, Ophir, Surprise, Valley.

At or very close to granite contacts : Asp, Bonsor, Colleen-Bawn, Don, Geelong, Globe & Phœnix, Morven, Tebekwe.

In Hornblende or Chlorite schist : Claremont, Criterion, Nelly, Northern Star, Sabi.

In Grit : Abercorn, Bell, Durban.

In Banded Ironstone : Bristol, Champion, Susannah, Ubigubi.

In most cases the lode-matter is fairly clean quartz with only a little finely disseminated pyrite, and occasionally galena or other sulphide as well. There are, however, some interesting exceptions. Thus, in the Bell mine, which has a vein probably averaging 10 ft. wide, the west end of the orebody is quartz, but the eastern portion is a soft chloritic aggregate, often containing masses of crystalline dolomite, with included fragments of country. The Blanket, Mont d'Or, and Jessie 'reefs,' as is nearly always the case in granulite country, are characterized by the presence of splashes of pyrrhotite ; in the last case accompanied by galena where the ore is richest. The Penhalonga contains crocoisite (lead chromate) near the surface and galena lower down, both these minerals being rich in silver. The Falcon and Valley lodes are heavily charged with sulphides, including pyrrhotite, iron pyrite, and copper pyrite. The latter has yielded considerable quantities of copper as a by-product and the former is expected to do so in the future. The Yankee Doodle (Selukwe Columbia Gold Mining Co.) and Bongola-Sheba reefs at Selukwe may be mentioned as sulphide lodes of quite a different type, rich in galena, pyrite and blende. They present, it may be mentioned, no treatment difficulties that cannot be overcome by fine grinding, though at one time considered highly refractory. The Champion at Gwanda contains much mispickel, altered near the surface into scorodite.

Impregnation Deposits.—We may now turn to the type of lode that has sprung into great prominence during the past few years, that in which the gold occurs impregnating a rock mass instead of being confined to a quartz vein. As an illustration of the importance of these lodes it may be noted that of the three largest producers and dividend-payers, two, the Eldorado and the Giant, are impregnation deposits, while all of the three largest developing mines belong to the same category. The Eldorado is in conglomerate or 'banket' and the Giant in a wide shattered mass of banded ironstone associated with talc and chlorite schists. The big Shamva orebody at Abercorn, on which a large plant is shortly to be erected, is in conglomerate and grit of a different lithological type from the Eldorado, but also of a highly metamorphic character. The banded ironstones contain a number of important impregnations, usually low in grade but of considerable width, though the Antelope mine provides an example of good grade, and widths no greater than many quartz veins. It is, however, in immediate contact with the granite. The Ayrshire, a mine once so prominent, is an instance of gold occurring in a granulite or gneiss at a granite contact. It is popularly termed a diorite, but is undoubtedly of contact metamorphic origin. In serpentine we have important deposits at the Gaika and the Cam & Motor mines, while the Arcturus-Slate group at Enterprise is in a peculiar variety of schist characterized by the presence of a green chrome-bearing mica. The following is a list :

In Banded-Ironstone : Antelope, Concession, Connemara, etc. (at Hunter's Road), Empress (Victoria district), Giant, Golden Kopje, New Found Out, Redrup's Kop, Sabiwa, Wanderer & Camperdown.

In Mica, Hornblende or Chlorite Schist : Arcturus, Slate, &c. (Enterprise district), Bushtick, Planet, Rouge.

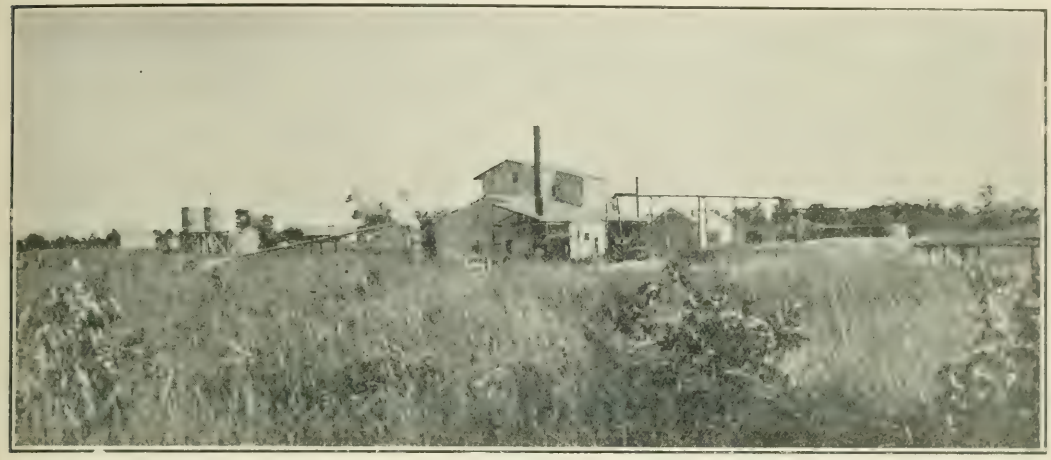
In Altered Serpentine : Blue Duck, Cam & Motor, Gaika, Robin Hood.

In Granulite, &c. : Ayrshire, Commonwealth, Jumbo, Hay, St. Davids.

Development of the Industry.—The presence of most of the above lodes, whether of quartz or otherwise, was revealed to the modern prospector by ancient workings, which had served usually to exhaust the bulk of the oxidized ore. There are no alluvial deposits worthy of mention, no doubt largely owing to the tropical character of the rainfall, and this, with the depletion of the surface-enriched lode stuff by the ancients, has prevented either big nuggets or sensational pockets from attracting a population of the same class as flooded the Californian and Australian diggings of the 'fifties. In spite of this, highly exaggerated expectations were originally entertained of the future of many mines that afterward proved incapable of supporting even the smallest mills. It was the failure to justify the reckless optimism of many of the earlier promoters that led to Rhodesia being regarded as a huge disappointment, and it is only during the last few years that developments have led to a reversal of this judgment.

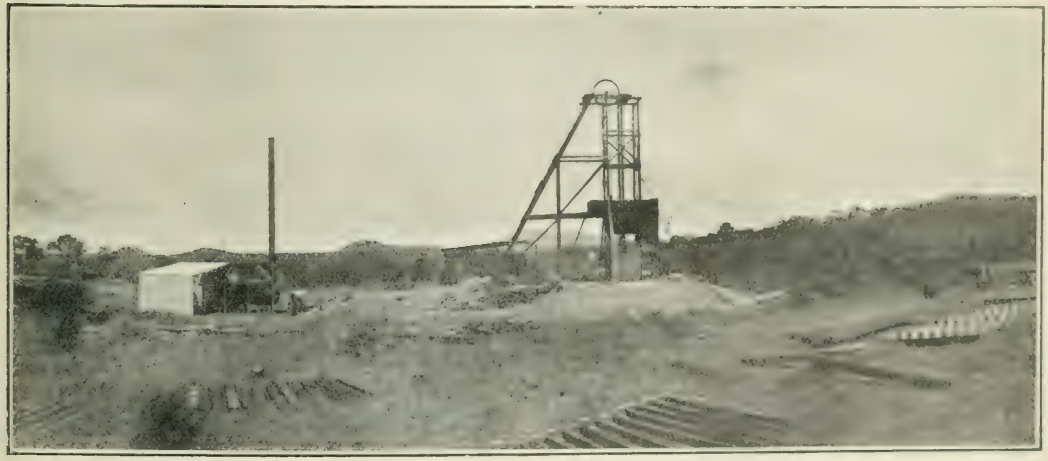
The recent revival of confidence is due in the first place to the small worker. Under the

original mining law, milling was only permitted after flotation of the claims into a limited company in which half the vendor interest had to be allotted to the Chartered Company. This '50% clause' is undoubtedly one of the severest



THE ETNA MINE.

exactions under which the mining industry of any country has ever suffered and even though it was speedily reduced to 30% it led to much over-capitalization, if nothing worse. There can be no doubt that the first great step in the direction of putting the industry on a sound basis was made when the visiting directors of



THE ANTELOPE MINE.

the Chartered Company in 1903 arranged to permit the working for profit (on a small scale only) of gold claims in return for a royalty on the gross output. At the time there was only one dividend-paying mine in the country—the Globe & Phœnix and many even of the residents were extremely pessimistic as to the future of the industry. In a few years the outlook had entirely changed, and by the beginning of 1908 the success of the small worker had not only put fresh faith into the average Rhodesian, but had begun to react favourably on the position of the larger companies. At present we are not through the transition stage due to the companies entering the field again as purchasers of properties opened up by the small workers. A few mines, such as the Lonely, are just ready to undertake production on a much increased scale, but an even greater number have ceased milling altogether during the progress of development work, and will not re-enter the productive class for some time.

The result of this state of affairs is that the industry has presented to outsiders the appearance of practically marking time, the output having been nearly stationary for three years, as the following figures indicate :

	Ounces of Gold.	Value.
1908.....	606,961	£2,526,006
1909.....	623,388	£2,623,708
1910.....	609,955	£2,568,198

At present fully one third of the total labour force is employed on non-producing mines, and, as a result of the development in hand, a number of large mills should come into operation next year on such mines as the Shamva, the Cam & Motor, the Arcturus & Slate, the Eileen-Alannah, the Antelope, the Kimberley, and the Sabi. Other smaller properties will help and several large low-grade bodies are also likely to swell the production. Without exaggerated optimism an increase in the total yield of at least ten to fifteen thousand ounces per month may fairly be anticipated in the immediate future. The maintenance of this improvement will depend entirely on the number of new discoveries made, and these will of necessity be virgin veins, as the possibilities offered by the remaining ancient workings are now strictly limited.

Labour Supply.—A dominant factor in the prospects of an improved output is that of labour supply. The progress of the industry is obviously dependent on the number of natives it is possible to recruit as labourers, and there is a constant shortage in this direction. Matters are not, however, by any means so bad as most people would have us believe. The amount both of local and imported labour has shown a constant tendency to increase and the recent re-organization of the Rhodesian Native Labour Bureau promises further improvement in the future. Moreover, there is no question but that the shortage leads to economy, and mine managers often find that their working costs go up as their complement of natives approaches the number of boys they reckon they ought to have. Another mine manager, who has achieved wonders on his own mine, attributes much of his success to employing relatively large numbers of white miners. There is, he considers, a tendency to place a white man in charge of more natives than he can really look after properly, and this may well explain the decrease of efficiency above noted as the result of an increased supply of native labour. It may be remarked that hand-drilling is almost universal and machines are only used on a few of the 'big' mines. With regard to white labour, the supply offers few difficulties, as immigration automatically ensues as soon as vacancies occur on the different mines in sufficient number to attract outside attention. The white miner is, of course, purely an overseer of the 'boys' who do the actual work, except that he is generally expected to do the blasting of the holes that have been drilled. White wages are high, as might be anticipated from the high cost of living. The following are typical of the ruling rates of pay per shift :

Miner	20s. to 22s. 6d.
Amalgamator	21s.
Cyanider.....	20s.
Engine Driver	20s. to 22s. 6d.
Carpenter	21s. 6d.
Fitter	21s. 6d.

Native wages vary considerably, according to the supply in different localities and the experience of the boys. Hammer-boys earn about 30s. to 50s. per month, plus food and quarters. Surface-boys can sometimes be got for as little as 15s. per month.

Water and Fuel.—The important questions of fuel and water supply may be briefly touched upon. In a country with tropical climatic conditions, that is to say with perfectly distinct wet and dry seasons, each extending over about half the year, water often causes trouble by its overplus at one period and its scarcity at the other. It cannot be said, however, that Rhodesia is a badly watered country and there are on the other hand only a few spots where the rainfall is really excessive for any length of time. The general average for the whole country must be a little under 30 inches per annum, of which the bulk falls from November to February. There are certain districts where surface water is lacking, except in the larger streams, during the greater part of the dry season, and some of these are difficult to prospect on that account. There is nevertheless seldom much difficulty in obtaining a good supply by sinking to a moderate depth, say about 60 ft., and it is often the places where least exists above ground that yield the most below.

Some of the big mines have to pump for considerable distances ; thus the Globe & Phœnix pumps 7 miles, the Gaika 6, the Shamva 2½, and so on. In no case, however, can it be said that any important deposits lie idle through lack of water. A large proportion of the smaller properties are able to run on what is pumped from their own workings or from pools in a stream close at hand.

As regards fuel, wood is in general use and

the timber of the country, scrubby as it is, has proved on asset of much value from this point of view. Rhodesia is fortunate in the possession of coalfields of considerable extent, and that at Wankie produced 180,000 tons of coal in 1910. It so happens, however, that the coal measures are always distant from the metamorphic backbone of the country on which the leading gold mines are situated, and this, in the existing state of railway communication, prevents coal being so generally used as would otherwise be the case, especially in Mashonaland. Suction-gas plants have therefore been utilized on a number of properties, and appear to have proved satisfactory. There can be no doubt that the timber of the country has led to a much greater extent of mining operations than could possibly have happened in such a bare area as the southern Transvaal. There the treeless veld could never have supported mines unless they were rich enough to justify the construction of a railway for their especial benefit to bring coal from a distance.

A small Rhodesian Mine.

The Eldorado Mine.

WORKING COST.—The Rhodesian mining industry is now in a healthy condition as regards working methods evolved from experience. In the early days extravagance was rife, though legitimate mining was costly enough in all conscience owing to the great distance from the railhead. Now the railways make quite a respectable show on the map—a remarkable one, indeed, when the smallness of the white population is considered. The condition of the wagon-roads still leaves much to be desired, but steps are being taken to remedy this, an important matter when it is considered that mines like the Lonely, Antelope, and Sabi are from 50 to 70 miles from the railway. The increase in the farming population has had the effect of decreasing the prices of maize and other food-stuffs as supplied by the mining companies to the native labourers; hence of reducing costs in this direction also. The maintenance of large clerical and other staffs, a legacy from the Rand, is quite unsuited to local conditions, and even on the large mines it is now considered unnecessary to have more than two or three men in the 'office.' The tributer had great influence in this direction. When it was found that he could secure profits on 5 or 6 dwt. ore, the London boards, which had hitherto been content to accept as normal costs reaching £2 or more per ton, began to agitate for similar results from their own mines. It then became necessary for their representatives in Rhodesia to demand greater efficiency from their subordinates, and a weeding-out process ensued, and ranged from miners up to consulting engineers. Even people who lacked real experience began to take an interest in what their neighbours were doing and a gradual reduction of costs ensued. At present about 25s. per ton may be considered as an average for mines of moderate size with comparatively narrow lodes. Larger bodies are worked much cheaper, and the Wanderer has been able to point to the proud record of 7s. per ton, treating its ore by dry crushing and direct cyaniding. The experience gained by this time is of much value to responsible engineers. They can now come to a rapid decision as to what 'prospects' are worthy of having money spent on their development, and far more can thus be done usefully for a given sum of money than was possible a few years ago. The same applies to metallurgical processes.

PERSONAL

ARTHUR R. ANDREW has returned to London from Colombia.

H. FOSTER BAIN, editor of the *Mining & Scientific Press*, was recently in Alaska.

SYDNEY H. BALL has returned from Brussels to New York.

J. M. BELL, on his return from Canada, left for Spassky on August 2.

LOUIS P. BOWLER, the author of 'Gold Coast Palaver' has arrived from Secondee, West Africa.

R. GILMAN BROWN is back from Kyshtim.

GEORGE P. CHAPLIN is in British Columbia on behalf of Bruce Marriott & Co.

EDGAR A. COLLINS, formerly of Tonopah, Nevada, is now assistant manager at the City Deep on the Rand.

W. CULLEN has returned to Johannesburg after a holiday in England.

G. A. DENNY is expected shortly from Mexico City.

R. FARINA has returned from the Altai, Siberia.

F. C. FREY is at Lebong Soelit, in Sumatra.

C. HANCKEL has returned from Australia.

HENRY HAY, who was recently married in South Africa, returned to West Africa on August 10.

C. A. HEUSSLER is now in Labrador, but he expects to return to Newfoundland before leaving for England in September.

W. A. HEYWOOD is in Spain, as consulting metallurgist to the Cordoba Copper Company.

H. LANCASTER HOBBS has returned from Northern Nigeria.

EDWIN C. HOLDEN, professor of mining in the University of Winconsin, passed through London on his way to Spain.

E. C. HOMERSHAM, the manager of the Prestea mine, is here from West Africa.

J. POWER HUTCHINS returned from the Ural region and is now at St. Petersburg.

J. T. KEATING has been appointed manager for the Kano (Nigeria) Tin Areas.

MARK R. LAMB has returned from the highlands of Bolivia to Santiago.

FRANK LANGFORD, the manager for the Braden Copper Co., is in London.

ALBERT R. LEDOUX sailed for New York on July 29.

C. W. LEE, formerly of the Geldenhuis Deep, is in London, on his way to Mexico.

THOS. H. LEGGETT, on his return from Paris, left for New York on July 15.

T. M. LOWRY, of Camborne, who has been for three years Inspector of Mines on the Gold Coast, has been appointed Inspector in Northern Nigeria.

GEORGE MACFARLANE and BERNARD HUNT returned from the Gold Coast in July.

EDWARD T. MCCARTHY is at Porcupine.

J. MORRIS, lately joint general manager of the East Rand Proprietary, has been appointed manager of the City Deep mine.

MAURICE PERCIVAL, manager for the Northern Nigeria Mining & Exploration Co. is expected in London.

C. R. PINDER is returning to South Africa.

C. W. PURINGTON has left St. Petersburg on his way to Vladivostok.

H. M. RIDGE is at Nelson, British Columbia.

P. A. ROBBINS is manager for the Hollinger Gold Mines at Porcupine.

WILLIAM ROBERTS is in Egypt.

THOMAS ROBINS is at Antwerp.

G. W. RUDYERD has gone to Northern Nigeria.

GEORGE SAFFORD was married on July 25 and sailed for Ecuador on August 2.

C. B. SANER has been elected president of the Chemical, Metallurgical & Mining Society of South Africa for the ensuing year.

A. L. SIMON is expected in London on his return from Siberia.

HOWARD D. SMITH sailed for New York on July 19.

G. E. STEPHENSON, manager for the Palmarejo & Mexican Gold Fields is due in London shortly.

J. W. H. STUBBS, late of the Randfontein, but now with the Albu group, left London for Johannesburg on August 5.

U. P. SWINBURNE has arrived from South Africa.

S. C. THOMSON sailed for South Africa on August 5.

J. B. TYRRELL, of Toronto, made a short visit to England, leaving on August 11.

S. S. WEBB-BOWEN has returned from the Celebes Islands.

H. C. WOOLMER, manager of the Spassky mine, has returned to his post.

A. BASIL REECE has resigned his appointment in Bolivia and will return to England in October.

BALL-MILL PRACTICE AT KALGOORLIE

By M. W. VON BERNEWITZ.

SO much has been written about the stamp-mill that other efficient pulverizers are apt to be overlooked; so I make no apologies in presenting these notes on the modern ball-mill, in this case the Krupp, in the hope that they may be of use to others who have a plant in operation, or contemplate erecting one. It is doubtful whether the ball-mill is operated with greater efficiency and less cost anywhere in the world than at Kalgoorlie, that is, crushing dry. We have had great experience with them, and with a constant interchange of ideas, each plant is well abreast of its neighbour, until there is a practical uniformity of practice.

The ores of the 'Golden Mile,' the richest portion of the goldfield, do not vary much in composition, and taken on average, it may be said that they are hard to crush. The ore averages 60% silica. In the Great Boulder the proportion is as high as 75%. Below are short descriptions of the ores treated in the dry-crushing plants:

Associated	Partly schist, rather above average in silica, hard, and highly mineralized.
Associated Northern	Main lode of schistose character, West lode hard and silicious.
Chaffers	Varies from schistose to hard flinty quartz, with 3 to 5% pyrite.
Great Boulder	Very hard cherty quartz with a little schist.
Kalgurli	Quartz diabase varying in hardness according to depth, some schistose, and other highly silicious. Average tough.
Perseverance	Schistose in structure, and contains pyrite and magnetite throughout.
South Kalgurli	Average 60% silica, with little schist, and is considered hard.

The following are analyses from the Associated Northern and Perseverance mines:

	%	%
Insoluble	60·60	63·46
Aluminium oxide	5·75	2·06
Iron bisulphide	5·32	6·80
Lime carbonate	11·19	13·42
Magnesium carbonate	5·29	6·93
Iron carbonate	10·23	6·80
Alkali undetermined	1·62	0·53
	100·00	100·00

The average ore is dry enough for milling, although the driest holds from 0·5 to 1% moisture. Anything above this amount retards crushing. As in a stamp-battery, or other type of crushing machine, a great deal of the efficiency depends on having massive foundations. So it is with the ball-mill. A mill on a solid block of concrete will crush better than one on a timber or steel girder, no matter how well braced. A springy support is bad for the gear, and does not allow the mill to be stiff, as it were. This has been noticed especially in the Associated plant built 11 years ago, in which 10 mills were resting on timber girders, and two on concrete piers, the latter doing far better work than any other pair in the plant. The former foundation consisted of a masonry bed, on which stood 12 by 6 in. steel girders with brackets riveted to support two longtitudinal pieces of jarrah (native hardwood) 12 by 14 in. across which were bolted three pieces of 12 by 14 in., for each mill. This would appear to be stiff enough, but the vibration was bad all the same. Now the big mills are on fine concrete foundations, reinforced with old wire rope and rails. The Associated Northern, Chaffers, Great Boulder, and Perseverance ball-mills are erected on massive concrete foundations, especially the last mentioned; those at the Kalgurli sit on steel girders 8 by 6 in. well braced and apparently firm; while in the South Kalgurli plant they are bolted to a frame of 12 by 12 in. timbers, well braced and standing on a concrete foundation. This looks a small structure, but it is free from vibration.

As soon as the foundations are sufficiently set, and the four bearings for the mill-shaft and pulley-shaft are lined up, the construction can proceed rapidly. With 8 men who understand the work, a mill may be erected in 24

hours. Everything is simple. The main walls are bolted or riveted to the cast-iron naves, which, when in their proper places, are keyed to the mill-shaft. The side liners are bolted loosely until all the mantle-plates with the grinding-plates are in position, then everything may be tightened, all bolts having check-nuts, except those on the mantles holding on the grinding-plates, which are riveted. The fitting of the scoops, baffles, inside and outside screens, is quite a simple matter. The feed-hopper is in two pieces for bolting around the shaft, and is lined for the wear of ore dropping from the feeder. Unless motor-driven, each mill has a fast and loose pulley on the pinion shaft. There are two sizes of mills at work in Kalgoorlie, with the following dimensions :

	No. 5 Inches	No. 8 Inches
Diameter	89	106
Width	46	54
Mantles for plates	10	12
Inside screens	5	6
Outside screens	10	12
Area of outside screens, each	46 by 26	54 by 24

The last item is the full area, without deducting that part of the screen covered by the wooden frame. Approximately, the net screening surface on each mill is 70 and 100 sq. ft. respectively.

The mantles carry four or five grinding, and one perforated, plates, which are tightly bolted together. The bolts have a feather on the tapered portion to fit into the plates, thus preventing turning during tightening. Bolted to the bottom end of the mantles are the baffle and scoop plates, which return the oversize to the mill. The whole mill is enclosed in a tight-fitting casing, made in convenient sections for removal during repairs. The spur-wheel, keyed to the mill-shaft, is usually of cast-iron, and should last, if well greased, fully four years ; while the pinion lasts about half that time. The loose pulley runs on a sleeve which must be well greased to prevent seizing. On one of the new mills at the Associated, a new idea for loose pulleys has been devised, in the shape of a cast-iron bracket with an extended hollow sleeve, bolted to the plummer-block furthest from the mill. The pinion-shaft revolves in this sleeve, and the loose pulley rests on the latter. When the mill is working, the pulley is at rest, thus preventing much wear at this point.

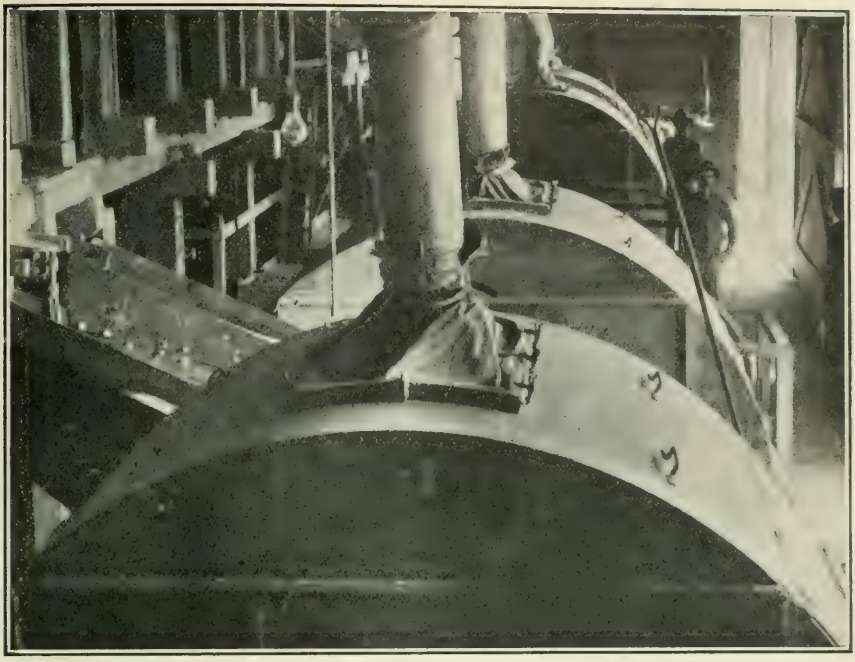
It is found that a good stiff light grease is best for all bearings on a ball-mill. A few turns of a grease-cup twice in 8 hours is generally sufficient. For the gear, old, but clean, grease from other bearings is good enough. Properly fitted gear, when well greased, makes little noise.

When driven off a main driving-shaft, tight and loose pulleys are required ; but when motor-driven, the former only is necessary. The Great Boulder people are fitting clutch-pulleys on the main shaft with satisfactory results. An 8 in. 6-ply balata or rubber belt is strong enough for a No. 5 mill, and a 10 in. 8-ply for a No. 8.

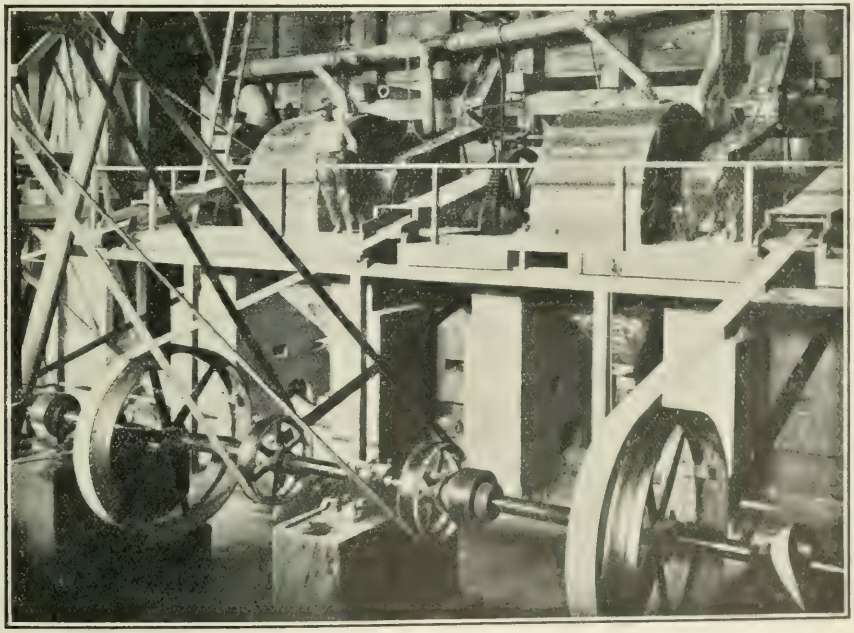
From 24 to 26 rpm. is the correct speed for the No. 5, and from 21 to 24 rpm. for the No. 8. It is generally admitted that the latter speed for the larger mill is quite safe and shows much greater efficiency, although the makers stipulate the lower speed. Mills are loaded with 1 to 2 tons of 5 in. steel balls according to size and hardness of the ore to be crushed ; there is no advantage in feeding several sizes of balls. Indicator diagrams at the Associated Northern and Associated have shown that the No. 5 mill takes from 18 to 23 hp. when in an average working condition, and the No. 8 consumes 50 to 60 hp. Where motor-driven, as at the Perseverance and South Kalgurli, the ammeters register 60 to 65 amperes at 550 volts.

It is found advisable to have the storage bin for coarse ore a few feet behind the ball-mills, as it enables a proper chute with a gate and a long feeder to be attached, thus giving a steady flow of ore, which cannot be assured when the bin is right over the mills, as originally erected at the Associated.

For the protection of employees, and keeping the plant free of dust, and the better working of a ball-mill, a strong fan attached to the mills by large piping is necessary ; and a plant properly arranged in this detail is a pleasure to operate. A couple of Sturtevant fans, about 4 ft. diam., running at about 800 to 1000 rpm. should keep eight No. 8 mills clear ; and a 3 ft. fan, as we have it at the Associated Northern, running at 800 rpm. is effective for three No. 5 mills. A 4 ft. motor-driven fan at the Associated takes 5 amperes. Suction and delivery pipes should be fitted with sliding doors to facilitate cleaning. The draft in the suction-pipe at the Associated Northern averages 0·33 in. The fan generally blows the dust into a canvas-lined house, in which it readily collects, or as at the last-named mill, it is blown into the second hearth of the Merton furnaces. At the Perseverance, the dust is collected in cyclone arresters, and then into



FOUR No. 8 BALL-MILLS AT THE GREAT BOULDER PERSEVERANCE.



TWO OF THE No. 5 BALL-MILLS BELONGING TO THE ASSOCIATED NORTHERN.

the main furnace flue. A strong draft aids in keeping screens clear, especially when the ore is at all damp, the steamy air being withdrawn. When dry crushing with stamps at Waihi in New Zealand, in 1894 to 1899, the beneficial effect of a fan was very noticeable. The amount of dust lost in dry crushing is difficult to estimate; but from observations I should say it would represent 1% at least.

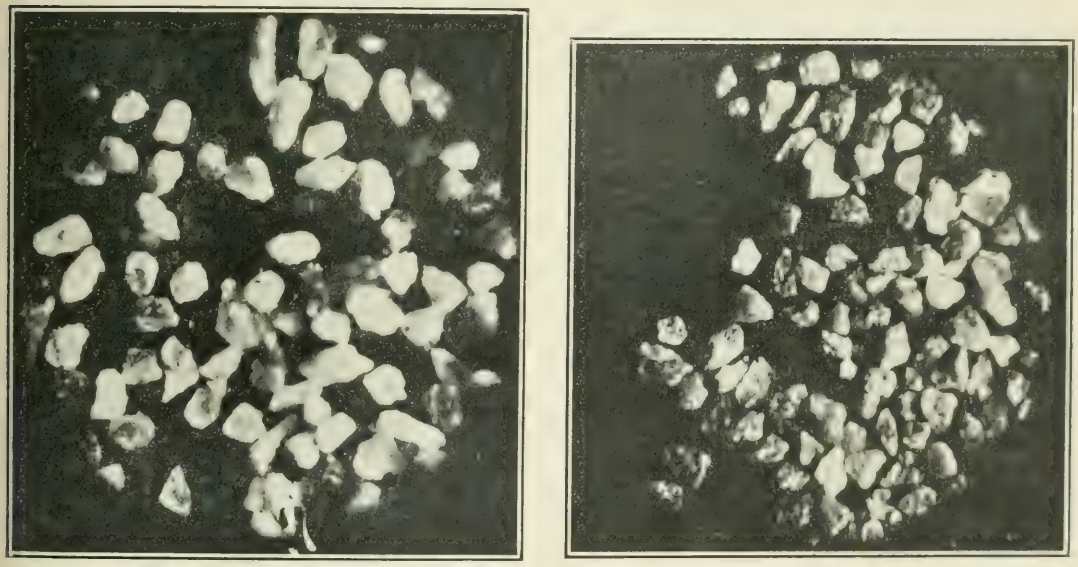
The ball-mill feeders are usually of the grasshopper or shaking tray type, that is, a sloping tray with sides 6 in. high at an angle of about 25°, suspended at the discharge end by a chain or rod from a beam above, and the top end supported by two iron legs, fitted loosely to the underside of the tray, and to a timber support near the floor. At the back of the feeder-tray is a tappet, and on a shaft is a single, double, or three-armed cam, adjustable to give as much as a 1 in. lift to the feeder. This pushes the feeder back, which, when released, drops forward by its own weight, discharging an even flow of ore into the mill. It is the custom now for each mill to have its own feed-shaft driven by a 3 in. belt from a pulley fitted to an extension of the mill-axle. The mills at the Perseverance are so fitted, the whole being neat and effective. At the South Kalgurli the feeders are arranged with a perforated tray, through which the fine ore passes to a shaking tray fitted with 27 by 27 in. screen, this in turn screening all that portion already fine enough, it passing to the conveyor beneath. We tried one for some time at the Associated Northern but did not think it increased the capacity of the mill. The arrangement requires close watching. Naves are arranged for left and right hand feeding, by this means mills may be run in pairs, the hoppers being reasonably close together; and it may be remarked here that mills should not be too close together, as plenty of space is required for repairs. The balls are fed either through the manhole door or hopper, and ore is added until the balls are well mixed with it. A mill should not be started without ore, as the balls knock the plates about badly. Unless a mill is motor-driven, it would be difficult to arrange for an automatic feeder. I have not heard of any, but think that one could be devised, depending on the increase of power consumed above a set point. If a mill takes 60 amperes with a full load, and is overfed to 62 amperes, then some automatic gear could shut off the feed. Like many other machines a ball-mill is worked by sound. This is an important point to impress on millmen, as a poor attendant may easily cut the efficiency of a mill by 25%, in not keeping his ears open. An operator becomes keen to the exact rumble of a ball-mill, and can detect a light feed from a distance. A mill running empty simply roars; when light there is a clear metallic sound of balls striking one another; when just right, there is simply a rumbling noise; while in a mill that is full, the balls and ore are carried high enough to fall directly on to the mill-axle or shaft, this being bad work, as the shaft is liable to be damaged and worn, and, of course, crushing is reduced to a minimum. The remedy for too much feed, of course, is shutting it off until the correct sound is noted. A millman not too sure about his feeding can easily see this by stopping the mill, and looking into it through the feed-nave with a light. The mass of balls and ore should be evenly distributed, and no bare balls should be showing.

The operation of the Krupp ball-mill may be described as follows: The mill is a gear-driven steel-lined drum, charged with 1 to 2 tons of steel balls, revolving at 26 to 24 r.p.m. according to size. The ore crushed by the balls passes through the perforated grinding plates, and is screened by the inside or coarse screen, the oversize being returned automatically to the interior of the mill; while what passes the inside screen is sized by the outside or fine wire screen, the oversize being also returned to the mill for further grinding. The action of crushing and returning the oversize is ingenious, and it will be seen that as soon as the ore is crushed fine enough, it must pass out of the mill. Herein lies the efficiency of the ball-mill. In a 5-stamp battery the ore is pulverized excessively by not being discharged directly it is fine enough. In the ball-mill there is little of this, and any machine that discharges its product immediately it is of the required size will show high efficiency. As regards the action of the balls, it has been stated that crushing is done by impact; but from careful observation I am perfectly satisfied that this is not so, the only impact that might take place is when the balls drop from one grinding-plate to another, a distance of five inches in a newly lined mill; and then, only some fine particles would be crushed by impact at this point. The action of the balls is one of pure rolling, grinding, and abrasion, they being lifted about level with the mill-shaft or axle, and then roll back, tumbling over one another, rubbing and grinding the ore. Of course, there is a great deal of attrition between the pieces of ore apart from the work of the balls. This is not mere

supposition, as I have actually seen the action. At the Associated mill, we had four No. 5 mills crushing our oxidized ore that carries some 5% moisture, so we used coarse screens, in fact the wire screens were removed, and the inside ones used only, these being punched steel with 30 holes per sq. in. In crushing this ore no dust is made, so by the aid of a portable electric lamp, placed well down in the feed-hopper, the balls and ore could be seen plainly. It was observed that the balls and ore were carried up nearly level with the shaft, and having reached this point, started to roll back. The 1200 lb. weight of steel was rolling and tumbling about, grinding and rubbing the ore between the balls. It was a most interesting sight, fully proving that there is no impact grinding. To confirm this, one has only to take note of the ore in a mill when it is stopped for repairs. Down to the small particles, say 6 mesh, it is smooth and round just as if water-worn from a river. Pieces of steel, which come from the mine at times, are rounded in the mill, although they hinder good work. If impact were the action in a ball-mill, dynamite, which also finds its way with the ore, would explode as it does in a Griffin mill; but it does not, and I take it that it is just rubbed away. F. B. Allen, Director of Technical Education in this State, has kindly examined some ball-mill product, which was wet-screened to clean the particles from dust, under the microscope, to see whether it had a sharp fracture or not, with the result that they show the +30 screen product to be somewhat rounded, and the +120 to have sharp, ragged edges. I saw the particles under the microscope, and was quite satisfied with the evidence.

This shows that the final particles are split by the rolling of heavy balls, not necessarily by the drop of a ball as in a tube-mill, described by H. Fischer in several of the leading technical journals in 1904.

Fig. 1 shows how perfectly round the balls continue in wearing from full size to the smallest, and the smooth round pieces of ore and steel. Fig. 2 is a micro-photograph of the final particles from a ball-mill. This excellent photograph was taken by G. Larcombe, of our local School of Mines.



MICRO-PHOTOGRAPHS OF BALL-MILL PRODUCTS.

In a table following Table I. will be found the consumption of steel and life of liners. Steel consumption is gauged by the weight of balls consumed per ton crushed, and not by the total balls and liners used, as in a battery where shoes and dies are calculated. The average steel consumption in the ball-mill plants here is 0·55 lb. per ton, while the hunch or grinding-plates last about 190 days, the perforated as long, and side liners about twice as long. Manganese steel of the Hadfield or Krupp make is most satisfactory. As regards capacity we may say that the efficiency depends on the quantity crushed per horse-power consumed. A No. 5 Krupp mill crushes ordinary sulphide ore up to 43 tons daily, and the

No. 8 up to 100 tons, and dividing this by the horse-power consumed (18 to 23, and 60 to 65) we get 2·1 and 1·6 tons per hp. respectively. In a small plant of 100 tons daily capacity, the No. 5 is a useful unit, but in a large plant the No. 8 is the best size. This has a large capacity, runs sweetly, and occupies little more space than the smaller unit. The quantity of ore crushed as given above is from actual weighings in some cases, and from the tonnage crushed divided by the hours run in others. On quartz the capacity of a No. 5 mill is lower, being about 36 tons per diem. We had excellent opportunities of finding out the capacity at the Associated Northern, as all the custom ore is weighed.

It is impossible to prevent damp ore, from 1 to 3% moisture, coming into a plant. Then the efficiency decreases greatly and the wear and tear becomes heavier, as the feed must be light to prevent screens clogging, a steaming being set up, that makes everything sticky. When crushing dry ore, the inside of the mill becomes hot from friction, a recent test showing up to 130° F. when the outside temperature was 97°. The Kalgurli used to dry its damp ore before milling, but rotary dryers are a nuisance. The soft oxidized ore can best be crushed, as at the Associated and Associated Northern, by only using about 1200 lb. of balls, taking off the outside screens, and passing it through the inside or coarse screens. Pans reduce this product quite easily. Actual tests show that a No. 5 mill will crush up to 82 tons daily, but for the 5% moisture the capacity would be greater. The Chaffers has one mill on this class of ore, wet crushing 93 to 100 tons through 26 by 26 screen per diem, using 2400 lb. in balls.

It is advisable to open mills for inspection once a week, unless something goes wrong in the meantime, and every two months the balls should be taken out and weighed, all balls under 1½ in. being discarded, as they are of little use in crushing, and the original weight made with new balls of 18 lb. each. Foreign matter, such as drill-ends, bolts, nuts, spanners, accumulate in mills, and as they hinder the smooth work of the balls they must be thrown out.

One man at 11s. 8d. per shift of 8 hours can look after eight No. 8 mills; but in smaller plants the millman attends to conveyors, elevators, dust-pipes, etc. Ball-mills should be fed with no larger ore than that which will pass a 3 in. ring. With fine ore the balls are apt to bed, as it were. Actual weighings have shown that a 3 in. feed is crushed faster, and the wear of steel less, than when the feed is about 1 in. with a lot of fine.

Grading analyses from ball-mills at different plants are given in Table II.

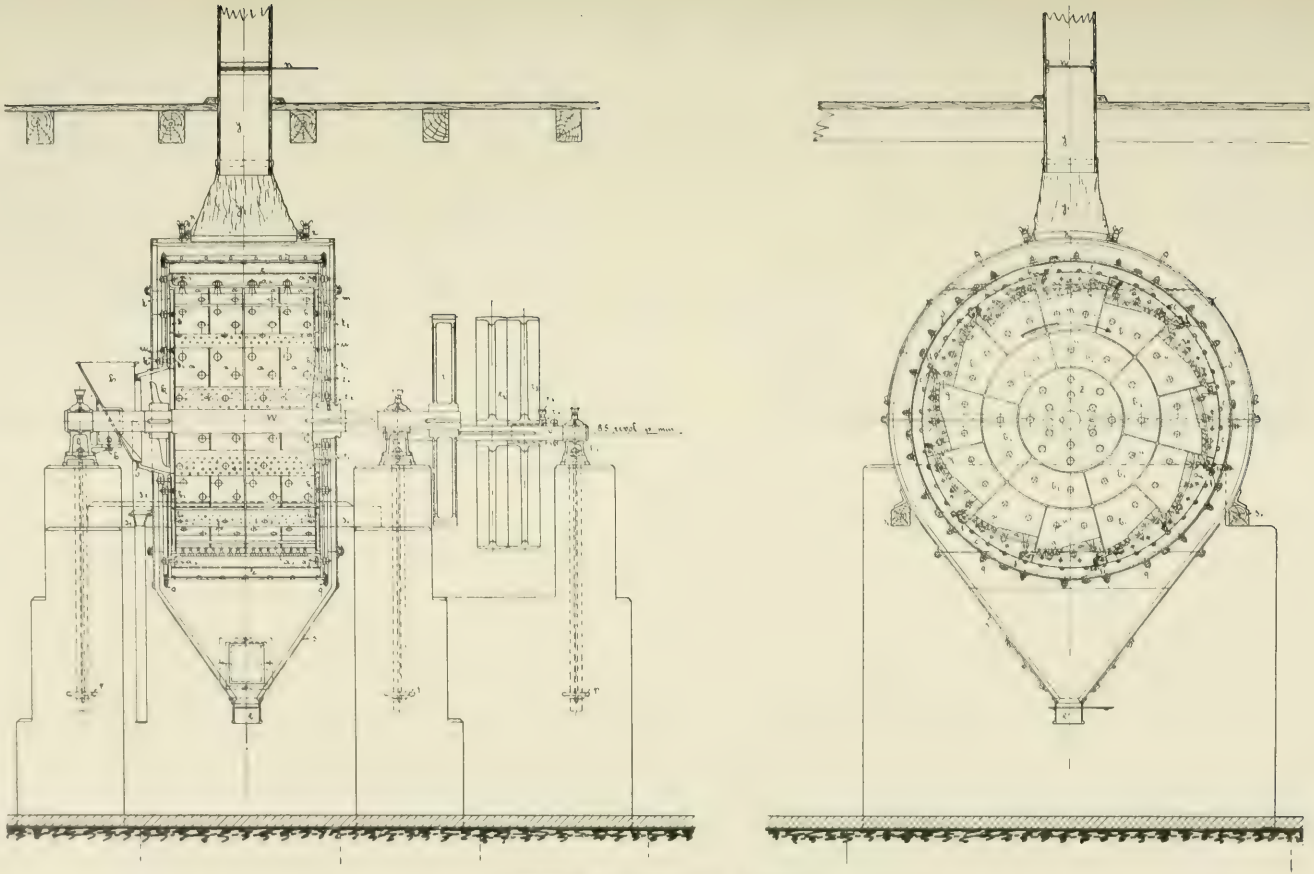
With the exception of the Associated and Great Boulder, whose screens are 30 by 30, the others are about 27 by 27. They are fairly uniform, although the −150 is low at the Associated, Associated Northern, and Kalgurli for some reason not understood. The ball-mill does not make so much −150 as the Griffin and other pulverizers.

The coarse screens used to be fixed to the mill by studs, but a local improvement was introduced in fitting them on with 1½ in. angle-iron, bent to circle and bolted. A large number of bolts are used in a mill, and cost a good deal. For some reason, perhaps expansion of plates due to heat, or loose plates, these break and fall into the mill, and then a lot of coarse ore gets through the bolt-hole to the space between the mantle and screens, causing the mill to run out of balance. Experienced millmen soon detect this. On account of this trouble, there is a difference of opinion as to the use of the baffle-plates fixed to the return scoop-plates in the mill.

The fine screens should be brushed once daily, if the ore is dry, and oftener if damp, by a wire brush. They last from 30 to 40 days, providing no stones work out and tear them. When the grinding-plates get thin and nearly worn to the mantle-plates, the mill requires re-lining. This is done differently in several plants; some millmen prefer to have a spare set of mantles and fix on the plates at leisure, and when the time comes for re-lining, just to take out those worn out, and fit in the prepared plates, this taking about 10 hours with 6 men; while others consider it best to leave the mantles in place, and cut off the old grinding-plates, and fit new ones as they proceed. This can be done in about the same time, but is awkward, heavy, and hot work inside the mill. There are several little points in practice on which we shall never be agreed, but their effect is trifling.

A No. 5 ball-mill, including foundations, may be erected for £600, and a No. 8 for £1000, bin and conveyors not included. The former will cost about £300 yearly for maintenance.

As regards wet-crushing, I have seen No. 4 mills at work in Broken Hill plants crushing jig-middling that passed a 8 mm. screen; a No. 5 on the Lake View Consols crushing sulphide ore; and the No. 5 at the Chaffers working on the soft, schistose, oxidized ore.



KRUPP BALL-MILL No. 8 TYPE.

a Hunched plates	*d* Iron wire screens	*g* Return channels	*r,r1* Gearing	*w* Main shaft
a1 Perforated plates	*e* Discharge end of dust casing	*h* Feed hopper	*r2,r3* Pulleys	*x* Frame for dust casing
a2 Mantle plates	*f* 6 broad and 6 narrow return scoops	*l, l1, l2.* Bearings	*s* Dust casing	*y* Air shaft
a3 Flange bolts	*f2* Protecting screens	*n* Slide for chimney	*t* Front wall	*y1* Connecting hose
b, b1, b2 Side plates		*o* Felting	*t1* Rear wall	
c Punched steel screens		*p* Foundation plates	*m* Manhole	

In the first instance the mills could not show great efficiency on such feed; in the second, the mill never had a real trial, as the grinding-pans and tube-mills were already overtaxed; while at the last-named the ore is so soft that, in any comparison with stamps on hard ore, it could not be used. Some years ago the Eclipse mine here had ten 900 lb. stamps crushing similar ore to the Chaffers at the rate of 10·5 tons per stamp per diem through a 20 mesh screen; so the capacity of the Chaffers ball-mill of 93 to 100 tons through a 26 mesh is somewhat better than the 10 stamps. The wet mill product is:

	%		%
+40	10·60	+120	3·56
+80	16·12	+150	7·59
+100	4·44	−150	57·69

The ore is crushed with weak cyanide solution in the proportion of 1·6 to 1. The wear and tear in the wet mill is almost twice as heavy as in the dry, the grinding-plates lasting 105 days.

Max Drott made some comparative tests on hard quartzite ores between a 5-stamp mill and a ball-mill for the Krupp firm, and the latter crusher showed an output of 40% above the battery, even the dry mill being better on the same ore. I am convinced that on a thorough trial, all things being equal, the ball-mill will show a greater output and efficiency than the stamp-battery. Will somebody take up this question, and show that the modern heavy gravitation stamp is not the most economical crusher for its present work and that there are other machines that can do the work better?

Costs of ball-milling are given in Table III. The methods of segregation of costs are not uniform, as will be noted at once. On some mines spares, stores, and repairs are lumped together. The cost of power is high at the Perseverance and South Kalgurli on account of motor-driving. The Associated is in a state of transition from the old No. 5 mills to the No. 8 size. The Great Boulder has lately installed a high-class steam-engine, and it is expected to reduce the cost of power to the above figure.

TABLE I. DETAILS OF BALL-MILL PRACTICE AT KALGOORLIE (dry-crushing).

Mine	Number of Mills	Weight of Balls lb.	Screens	Speed R.P.M.	Power H.P.	Drive	Capacity. Tons Daily	Steel Consumption lb. per ton	Life of Grinding Plates Days
Associated	4 No. 8	4480	30×30	21	60	Belt from shaft ...	92–95	0·50	170
	6 „ 5	2240	25×25	25	23		43		
Associated Northern	3 „ 5	2350	27×27	26	18	„	40	0·32	270
Chaffers	3 „ 5	2300	27×27	25	25	„	40	0·74	180
Great Boulder ...	4 „ 8	4480	30×30	24	60	Belt from shaft and			
					25	friction clutch	80–90	0·64	105
Kalgurli	9 „ 5	2200	26×26	25	60	Belt from shaft ...	40	0·45	300
Perseverance ...	8 „ 8	4400	27×27	24	65	Motor and Belt ...	100	0·65	118
South Kalgurli ...	3 „ 8	4480	27×27	24	30	„ ...	95–100	0.47	210
	1 „ 5	2800	—	—	—				

On an average, 63,000 tons monthly are dry-crushed in ball-mills on the Kalgoorlie goldfield.

TABLE II. GRADING ANALYSES.

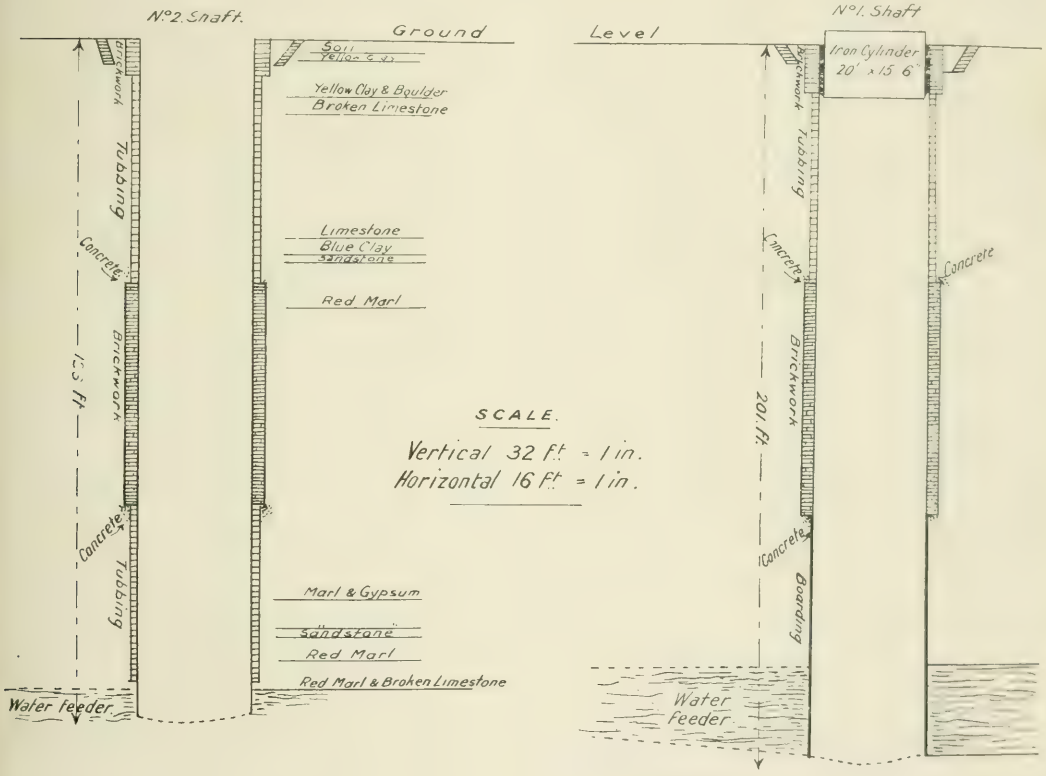
Name	+30	+40	+60	+80	+100	+120	+150	−150
Associated	—	16·16	15·66	10·46	6·43	3·76	3·46	44·00
Associated Northern ...	—	11·20	20·10	8·30	11·80	3·20	2·00	43·60
Chaffers	—	10·25	13·19	8·60	7·25	2·70	2·70	56·30
Great Boulder	1·00	5·80	14·20	8·70	9·00	2·30	2·30	52·00
Kalgurli	—	8·20	18·00	13·40	9·10	2·40	2·40	45·30
Perseverance	0·20	3·80	20·00	7·80	5·40	4·00	4·00	54·20
South Kalgurli	—	10·20	21·20	6·00	2 60	3·10	3·10	55·90

TABLE III. COST IN PENCE PER TON.

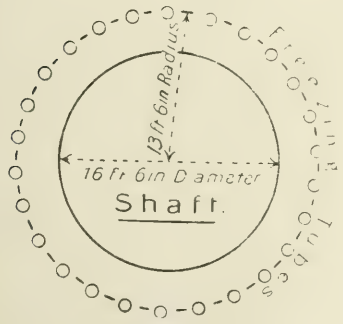
Mine	Wages	Power	Spares	Stores	Repairs	Sundry	Total
Associated	6·45	13·78	6·73	2·67	0·49	—	30·11
Associated Northern ...	5·87	12·08	4·73	1·42	0·10	—	24·22
Chaffers	2·09	10·64	—	0·25	6·88	1·71	21·57
Great Boulder	1·81	9·75	—	6·26	—	—	17·82
Kalgurli	—	15·23	—	7·49	—	—	22·72
Perseverance	3·21	19·18	3·32	0·46	0·11	0·54	26·84
South Kalgurli	2·05	20·82	5·54	—	3·68	0·21	32·30

PRÉCIS OF TECHNOLOGY

Shaft Sinking in Wet Ground.—The Great Central Railway *Journal* for March contains an account of the sinking of shafts at the Bullcroft colliery near Doncaster, Yorkshire, by means of the freezing process, through wet strata. Two shafts were commenced in June 1908, and all went well until a depth of 100 ft. was reached, when water started to come in at the rate of 1000 gal. per minute. Iron tubbing was inserted and sinking was started once more. In February 1909 when the depth was 180 ft. a more serious influx of water took place, so centrifugal pumps were employed capable of raising over 6000 gal. per min. This however proved of no avail, as the ground collapsed at the bottom of the shafts. It was then decided to obtain the advice and help of the Shaft Freezing Company, and under the direction of Emil Dietz, the freezing of the ground was undertaken. For this purpose 26 holes were bored around each shaft along the circumference of a circle 27 ft. diam., the shafts being 16 ft. 6 in. diam. These holes were sunk to 300 ft. and freezing tubes inserted. An ammonia plant was erected and by its means brine containing 26% magnesium chloride was cooled to *minus* 12°C. This was forced into the freezing tubes by pumps. The results at first were disappointing because the water continued to flow from the mouth of the shafts. It was found to be absolutely necessary that the flow should be stopped, so an iron cap, 20 ft. high and 15 ft. 6 in. diam., was



VERTICAL SECTION OF BULLCROFT SHAFTS.



Freezing Tubes round Shaft.

fixed at the mouth of the shafts. This effectively stopped the water from rising, and three months afterwards it was possible to draw the water from the shafts. Previously to doing so, a number of test holes were bored to 180 ft. depth and any cavities discovered were stopped by cement. The unwatering was commenced at No. 1 shaft on October 23, 1910, and a week later sinking operations were resumed. No. 2 shaft was afterward unwatered and sinking recommenced. The brick lining was replaced by cast-iron tubbing, and at a depth of 307 ft. the bed plates for the tubbing were inserted. Below this depth it was not necessary to freeze the strata as they were not water-bearing.

The article also gives an interesting account as to the sources of the flow of water, thus elucidating the cause of the trouble.

Extraction of Mercury from Low-grade Cinnabar Ores.— In the *Australian Mining Standard* for June 8, C. A. Mulholland gives an outline of a wet process that he has used on a small scale for extracting cinnabar from low-grade ore. At present such ores are roasted and distilled direct, as the cinnabar is too friable for concentration. Mr. Mulholland's process utilizes the known fact that cinnabar is soluble in a mixture of alkaline sulphide and alkaline hydrate. He slimes the ore in a solution of these, and subsequently completes the reaction in an agitator heated by a steam jet. After settlement the solution is removed and the residue washed with another solution intended for the next batch of ore. The solution containing the mercury is treated with zinc hydrate ; zinc sulphide and mercurie sulphide are precipitated. The solution then contains nothing but alkaline hydrate, which may be partly reconverted into sulphide by passing sulphuretted hydrogen through it. The mixed sulphides in the precipitate are treated with dilute sulphuric acid and steam ; sulphuretted hydrogen is evolved, the zinc goes into solution, and the precipitate consists of mercuric sulphide and metallic mercury, which is then treated in the usual way. Zinc hydrate can be recovered by treating the sulphate by alkaline hydrate. The success or otherwise of this process will depend on the prices paid for the alkaline sulphide and hydrate, the zinc hydrate, and sulphuric acid, and on the amount of regeneration possible. Also the ore will have to be free from constituents such as metallic oxides ; otherwise the consumption of alkaline sulphide will be fatal to the process.

Mine Temperatures.—At the May meeting of the Chemical, Metallurgical, and Mining Society of South Africa, J. Whitehouse and W. L. Wotherspoon read a paper detailing their investigations into the temperature of the rocks and mine-air on the Rand. They gave full details of their records of air temperature at the Village Deep, before and after the installation of the ventilating fan, both as regards temperature and humidity. In the part of the paper dealing with rock temperatures, the authors give a chart on which are plotted isolated records at various mines on the Rand. They deduce a mean average rise of temperature of one degree Fahrenheit for every 253·9 ft. of depth vertically, and 98°F is predicted as the temperature at 7000 ft. Five years ago H. F. Marriott calculated that the average increase of temperature was one degree for 208 ft. The authors do not give details of the method of recording these temperatures, that is to say, whether they represent the temperature of the rock before development, or of the rock at the working face before much heat has had opportunity of escaping into the mine air. Their figures show a lower rate of increase of rock temperature than Mr. Marriott's. No doubt further information will be presented in the discussion on the paper.

Steel Production of the World.—The *Engineering and Mining Journal* for June 24 reviews the progress of the steel industry of the world. The total production for 1910 was estimated at 58 million metric tons, as compared with 53½ million tons the year before. The increase is due partly to the general recovery of business from the slump of 1907, and partly to the increasing use of steel in place of cast iron, wrought iron, and wood. Cement is the only serious rival to steel nowadays, and even its use involves the employment of much steel. The above remarks refer especially to the United States, where 95½% of the pig iron production goes to the steel plant, and to Germany, where the proportion is 92½%. In Great Britain steel has not replaced wrought iron to anything like the same extent, for the reliability and toughness of wrought iron are still appreciated. The following are the figures for the production of steel, in metric tons, of the three chief countries :

	United States	Germany	Great Britain
Converter :			
Acid	9,563,376	171,108	1,156,313
Basic	.....	8,030,571	651,268
Open-hearth :			
Acid	1,231,575	252,148	2,695,482
Basic	15,537,006	5,125,421	1,603,793
Crucible	124,260	83,202	.....
Electric, etc	56,220	36,188	.....
Total	26,512,437	13,698,638	6,106,856
Proportion of steel to pig iron	95·6	92·6	58·8

The adoption of the basic or acid process is of course determined by the nature of the ores, but this does not account entirely for the differences in practice. For instance nearly 60% of the German steel is made in the basic converter, but this process is not employed at all in the United States, though 60% of the steel produced there is basic. Exact comparison is not possible, because of differences in the methods of classification, especially at the borderland between mild steel and puddled bars. The British figures are also incomplete, as no returns are available for crucible steel and electric steel.

Determining Copper in Pyrite.—The *Engineering and Mining Journal* for June 17 contains a translation of an article by W. N. Iwanow that appeared in *Chemiker Zeitung* for May 18, giving a new method of determining copper in crude and spent pyrite. This is based on the suggestion made by Groeger in 1891 that by heating pyrite (FeS_2) with pulverized metallic iron, the monosulphide is formed, and that the test reaction would thus be simplified. Iwanow follows up this method and applies it to spent pyrite as well as raw pyrite, and shows that by heating the Fe_2O_3 with metallic iron, the monoxide (FeO) is formed, which is easily soluble in hydrochloric acid. Thus the copper present in the pyrite is readily separated and determined. The author describes his method in detail thus : Three grammes of finely pulverized crude or spent pyrite is mixed with an equal quantity of powdered iron and put into a tube of thin glass about 3 in. long by ⅝ in. diameter, closed at one end and open at the other. The mixture is covered with a thin layer of finely divided iron, and the tube heated for a few minutes over a Bunsen burner to a red heat. It is then placed with its contents in an Erlenmeyer flask of 250 cc. capacity, and a few drops of water squirted on it, when it will burst to pieces. After cooling, 50 cc. HCl is poured in and the flask is heated on the water-bath until the fused mass is completely dissolved, which will take about half-an-hour. As some H_2S is freed in this operation, the copper is partly precipitated. Then the solution is diluted to 200 cc. and a vigorous current of H_2S passed through it. The precipitate of CuS is filtered off with other impurities, and dissolved in HNO_3. The iron is precipitated with ammonia and the copper determined electrolytically. The copper sulphide may also be dissolved directly on the filter with HNO_3, the solution neutralized with ammonia and electrolysed. The author gives tables of comparative results obtained by his method and by Lunge's and the nitric acid methods. The question of accurately determining the small amounts of copper in pyrite is an important one, as those connected with the sale of cupriferous pyrite well know.

Slime Settlement.—In the *Monthly Journal* of the Chamber of Mines of Western Australia for May, B. L. Gardner describes a new device for thickening slime adopted at the Sons of Gwalia mine. The slime at this mine is slow-settling and requires a large plant for settlement by stages. Owing to the large amount of magnesium salts it is impossible to use lime for hastening the operation. The method adopted is to provide additional areas for settlement by inserting in the spitzkasten a series of inclined sheets of corrugated iron, thereby increasing the rate of settlement. The principle of this idea may be explained by the experiment illustrated in the accompanying Fig. 1. A glass cylinder full of slime was placed in the ordinary upright position, and the rate of settlement was found to be 40 mm. per minute. It was then re-agitated and inclined at 45° as in the illustration; the rate was then found to be 180 mm. per minute. The reason for this increase in the rate is that on the upper side of the cylinder a stream of clear water flows upward and joins the supernatant clear water above the pulp. The

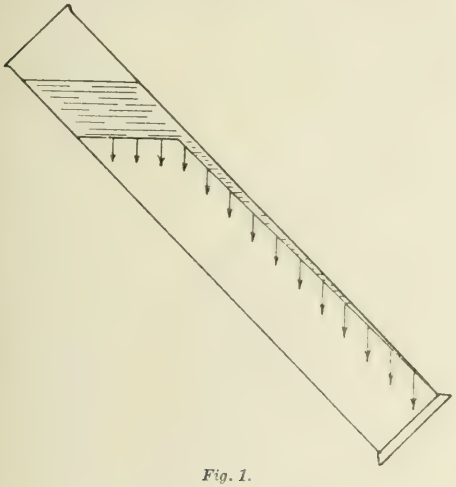


Fig. 1.

particles of solid settling in a downward direction leave upon the lower face of the tube a layer of clear water, which is displaced upward owing to its lower density than the pulp. In applying the principle, the inclined iron sheets are fixed as shown in Fig. 2. The corrugations serve the purpose of deflecting the flow into narrow streams which do not disturb the slime. It is best to set the sheets parallel to the current so as to impede the flow of the pulp as little as possible. In comparative tests with and without the sheets the following results were obtained:

	Spitzkasten 24 by 8 ft. with settling device.	Spitzkasten 24 by 24 ft. without settling device.
Amount settled lb. per minute..	49·1	155·6
Percentage of dry slime.....	41·1	26·1

The tests were made on sulphide slime, the inflowing pulp containing 15 to 18% solid. It will be seen that the amount of pulp fed per minute is practically the same per unit area of the spitzkasten, but that with the settling device the resulting pulp is 50% thicker. Thus the efficiency of settlement is notably increased, by means of a cheap apparatus that can be applied without trouble to any existing plant.

Specular Iron-Ore in Huelva.—*Diaria de Huelva* for April 4 reprints an article from *Revista Minera* written by Juan Hereza, on the specular iron-ore deposits in the province of Huelva, Spain. In Huelva, according to Gonzalo Tariso, the Archæan formation is represented by Laurentian and Huronian rocks.

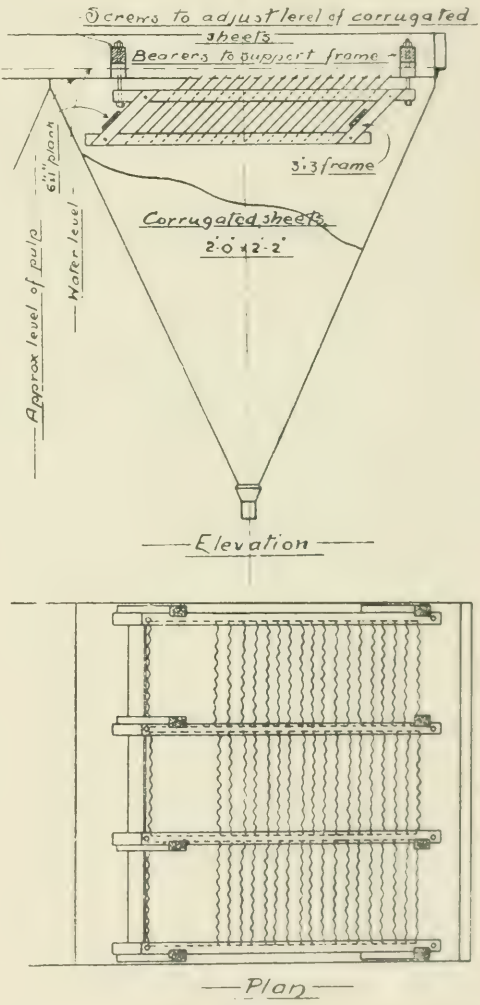


Fig. 2.

The former are composed of micaceous gneiss, replaced here and there by cordierite (iolite)-, hornblende-, and epidote-gneiss, or are substituted by granitoid gneiss. At the base of the upper subdivision (Huronian) mica schists (*micacitas*) are little developed; there usually occur in contact with the gneiss of the lower subdivision (Laurentian), talcose schists with sericite, which contain more and more clay until they become phyllites or argillaceous-talcose phyllades. In the gneiss, as well as in the talcose

schists and phyllites, are intercalated beds of crystalline limestone. The Jabugo deposits occur in the talcose schists and at the gneiss contact.

The following explorations have been effected by the Soria Mining Co. : (1) Costeaning-pits (*calicatas*) exposing specular iron-ore ; (2) A trench (*trinchera*) opened at one point on a bed of specular iron-ore 5 metres thick ; (3) Four shafts, 15 to 20 m. deep, in the bed or beds which constitute the formation. So far only one bed of iron-ore is known, but the company will put down bore-holes and deepen one of the shafts in order to ascertain how many beds exist, and to exploit the same.

The ore is specular iron-ore (*oligisto*) containing some magnetite. The iron varies from 45 to 70% (average 60%). Silica is not abundant, there is little sulphur, and only traces of phosphorus. The matrix is calcareous (formed by substitution) and quartzose. The quartz is scarce and occurs in small veins with pyrite and chalcopyrite, and sometimes with galena. This appears to indicate that one single appearance (*una sola aparicion*) of complex sulphides may have given rise to the greater part of the metalliferous deposits of Huelva (excepting those of manganese, whose origin is very different), thus: (1) The sulphurous emanations encountered at the contact, or near the eruptive centres, places of easy access to points where the schistose strata have been broken and triturated by dynamic action, and, in this way, the great masses of ferro-cupriferous pyrite may have been formed. Epigenic action, due to the upper hydrostatic circulation, has hydroxidized the upper part of the deposits, and produced a kind of natural cementation in the middle portion (mesogenic), enriching them in a zone of variable thickness, until, entering the lower regions (endogenic) we gain a proximate idea of the average composition of the primary sulphurous carriers (*aportes*). Another order of the phenomena of metamorphism has afterwards produced the crystallization of the mass originally in a pasty condition.

(2) A portion of the sulphides has been oxidized or has been directly dissolved in acid waters, giving the sulphides mobility to reach points, where, by the special constitution of the formation, substitution deposits have been formed, the different metals forming part of such in a proportion depending on the quantity of each in the place of origin, on the grade of solubility of the salts, saturation of the solutions, heat, pressure, etc. Iron sulphide constitutes more than 95% of the normal pyrite.

(3) Another portion of the sulphides dissolved, may be, by alkalies, were also able to travel far from the eruptive centres, and form concretionary deposits of complex sulphides, which do not show a banded structure (*estructura fajeada*) but which are confusedly mixed (*confusamente mezclados*) as coming from one single centre.

The band of Archæan rocks runs from east to west in the province of Huelva, and is continued into Portugal, in which country mines of specular iron-ore and magnetite, in connection with crystalline limestone have been explored from ancient times, so that it would not be strange if analagous deposits were discovered hereafter in Cortegana, Aroche, and Rosal de la Frontera (Spain).

The Gold Industry of the Rand.—On June 28 the annual James Forrest lecture was delivered to the Institution of Civil Engineers, by F. H. Hatch, the subject chosen by him being the "Past, Present, and Future of the Gold-Mining Industry of the Witwatersrand." We cannot do full justice to this paper on account of the exigencies of space, so we will deal chiefly with the historical statement and the author's own views and opinions.

The growth of the Rand was at first slow. Some of the earliest workers believed that the auriferous gravel, exposed in shallow open workings, was a superficial deposit like the placers of California and Australia. But the true character of the conglomerate beds was soon realized by those who had some geological knowledge, and by 1887 stamp-mills were in operation. The output from the Witwatersrand mines for that year was £81,045. Down to the water-level, at a vertical depth varying from 200 to 300 feet, the conglomerate beds were free-milling. Below the water-level the colour of the rock changed from red to blue ; the ore became pyritic ; and the gold was no longer so amenable to amalgamation. This was the first difficulty that had to be overcome. Up to the year 1890 the treatment of the Rand ore consisted of crushing in stamp-mills, and the recovery of 50 to 60% of the gold by amalgamation. Usually the pulp leaving the amalgamating plates was also run over blanket-strakes, with the object of retaining the rich black sands (that is, iron ore produced by the oxidation of pyrite). In some cases Frue vanners were in use, the resulting concentrate being sold to the chlorination custom works. But the tailing received no further treatment, and being considered valueless was, where the ground permitted it, allowed to flow away, or at least no great pains were taken to conserve it. The knowledge that, when the free-milling ore became exhausted, the pyritic nature of the rock would increase the difficulty of gold extraction, caused the greatest anxiety on the Rand. But the successful introduction of the cyanide process in 1890 dissipated all these fears, and a new era in the history of Rand gold mining was inaugurated at that date. It soon swept away all the costly methods of concentration by Frue vanners and other shaking tables, and the subsequent roasting and chlorination of the pyritic concentrate ; and thus cheapened the treatment while it increased the extraction. At first on account of its slime content not more than 50% of the pulp was suitable for treatment by percolation with cyanide solution ; and of the gold contained in this, some 65% was extracted. In other words, only 30% of the gold, left in the pulp from the amalgamating tables, was recovered. Hennen Jennings then introduced the method of treatment by hydraulic classifiers whereby a considerable proportion of the slime was eliminated and a sand product obtained, which could be run direct to the leaching-vats. A further improvement was the use of the Butters and Mein distributor. The treatment of the slime, which for some time after the introduction of the cyanide process remained a waste product, was the problem which next engaged the attention of the Rand metallurgists. In the year 1894 experiments were made independently by Charles Butters, on accumulated slime at the Robinson mine, and by J. R. Williams at the Crown Reef mine, with such success that thereafter slime treatment became general. Briefly, the process consisted in causing the slime overflowing from the sand-collectors to settle by the addition of lime, and the subsequent removal of the bulk of the water by decantation. The concentrated slime, so obtained, was agitated with cyanide solution, which was ultimately drawn off by decantation. The separation of sand from slime by the hydraulic classifier and the decantation method for the removal of water or solution from sand or slime, are now giving place to the use of diaphragm-cones and vacuum-filters.

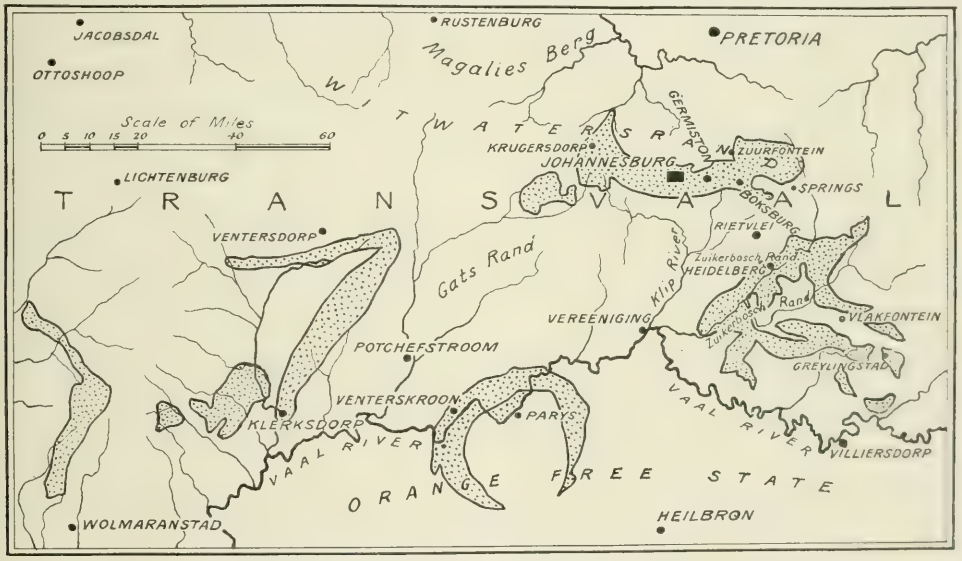
Dr. Hatch proceeds to describe the Caldecott classifying cone and the Butters filter, and enumerates their

applications. He discusses the relative advantages of zinc shavings and zinc dust as precipitant, and reviews the methods of comminution. He voices the opinions as regards other machines than stamps, and the difficulties of introducing innovations thus :

Now that the stamp-mill has been shown to be a crushing machine, representing only one stage in a series of successive comminuting operations, namely (1) by rock-breakers, (2) by heavy stamps, (3) by tube-mills, it may be questioned whether the work of the stamps (namely, reduction from 1 to $\frac{1}{4}$ in.) could not be equally well done either by rolls, or by mills of the Chilean type, or, perhaps, by a combination of both. The combination is favoured in the United States. According to Philip Argall, Chilean mills of 6 ft. diameter, running at 33 revolutions per minute, on Cripple Creek ores, will reduce 4 tons per hour, 60% of which will pass 150-mesh, the feed having been previously rolled to pass a $\frac{3}{8}$ in. aperture. In this case, rolls and Chilean mills do the work of stamps and tube-mills on the Rand. The charge is sometimes made that Rand metallurgists are unduly conservative, and that they are averse to the introduction of new processes, which may even have been shown to be successful elsewhere. But this conservatism is justified ; the scale of operations on the Rand is so enormous that even minor changes in existing practice cannot be risked, without prolonged investigation and actual trial under regular working conditions on the spot. The seriousness of even a small loss per ton, which might result from an unwise change of practice, is shown by the fact that on one of the largest plants a difference of 0·1 dwt. per ton is equivalent to £18,000 worth of gold per annum.

Dr. Hatch proceeds to review the underground problems connected with labour, dust, ventilation, transport, drills, sand-filling, and power-production. As regards ventilation he remarks that it is hampered by the small air-space and large frictional resistance of the rectangular timbered shafts, at present in use on the Rand. For this reason many of the deeper shafts of the future will, no doubt, be of the circular type, with either brick or concrete lining. Main levels and underground inclined shafts will also be driven in the footwall. These will serve as intakes for the air current, and, being in solid ground, will reduce the loss of air by short-circuiting to a minimum. Since these main ventilating roads, instead of following the regular course of the reef-plane, are driven straight, they will also be admirably adapted for cheap mechanical transport. The use of sand-filling will incidentally aid ventilation by restricting the spaces to which the currents of air can gain access.

The author then discusses the probable future of the Rand, his arguments being based on the cost of mining and the limit of profitableness of the ore. He takes the figures for the first quarter of 1911 for the results at the Robinson, Primrose, Simmer & Jack, East Rand Proprietary, Witwatersrand (Knights), Knight's Deep, and Glencairn, and shows that their average costs were 13·8s. This result has been brought about by increasing, to their economic limit, the size of the units used in the various operations, such as trucks, stamps, tube-mills, vats, pumps, etc. ; by the simplification of the methods of handling ore ; and by replacement, so far as it is economical to do so, of hand-labour by mechanical appliances. Working at a cost of 13·8s. per ton means that the cost of development, extraction, and reduction, including administration is covered by a recovery of $3\frac{1}{4}$ dwt. of fine gold per ton. On 5 dwt. ore, therefore, this would allow of a profit of nearly 7s. 6d. per ton. And it is only necessary to look at the value of the ore reserves of many of the big mines to see that this is not far from the average grade of much of the ore which the engineers propose to work in the near future. It is clear that over a considerable area of the Rand the average grade of the orebodies is not much above 5 dwt. The inclusion of large tonnages of relatively poor reef, which formerly were considered outside the range of practical mining, has been made possible by lower operating costs. The grade of the ore crushed has fallen in consequence. This does not necessarily imply that the increased depth of the mines has caused a falling off in the actual value of the ore deposit considered as a whole. The author has not been able, with the material at



OUTCROPS OF THE WITWATERSRAND SERIES.

his disposal, to come to any definite conclusion on this point; but he is inclined to the view that a gradual impoverishment with depth does exist. It would be quite possible from existing records and assay plans to settle this really vital question, but hitherto no figures relating thereto have been published by any of the big houses.

The effect of this increased tonnage and diminished grade on the life of the Rand goldfield as a whole is an interesting subject for speculation. Some few years ago, T. H. Leggett and the author estimated the production of gold to be expected from the Main Reef series, if worked to a vertical depth of 6000 ft. Up to that date (1902) the Rand had already produced gold to the value of £76,800,000; and they calculated that another £1,233,500,000 could be produced down to the depth stated. The average of the figures for gold-recovery used in the estimate was 38s. to the ton. The actual recovery at the time averaged 42s. It has since fallen to 28s. 6d. But, on the other hand, large bodies of ore are now being worked that were then passed over as unprofitable. No doubt, to a large extent, the one factor cancels the other; so that for the purposes of a rough estimate we may still make use of the sum total then arrived at.

Between the years 1902 and 1911 the Rand has produced £187,000,000. Deducting this figure from the sum total, there remains £1,046,000,000, which, on the basis of an average output of £30,000,000 per annum, is equivalent to a life of 35 years, down to a vertical depth of 6000 ft. But, if at still greater depths the banket should contain sufficient gold to yield a profit, after deducting the cost of working (which, under the best conditions existing at the present time, is 12s. 6d. or about 3 dwt. of fine gold to the ton), we may rest assured that it will be worked. The limiting factors are (1) the mechanical difficulty of raising the ore to the surface from such great depths, and (2) the effect of the temperature gradient. With regard to the mechanical question, the electrical transmission of power applied to stage-winding has so modified the mining engineer's conception of the depths from which hoisting is practicable, that it is now generally assumed that there are no mechanical difficulties that cannot be overcome if it pays to do so. In respect to the temperature question, Mr. Marriott's experiments have shown that the rock temperature at 7000 ft. would be only 97·5° F., and with efficient ventilation the air temperature would of course be considerably lower. It follows, therefore, that for all practical purposes the whole question turns solely on the gold content, and what that may be at a vertical depth of 7000 or 8000 ft. no one can tell. This much, however, may be said: the geological structure of the country clearly indicates the continuance of the conglomerate or banket beds to still greater depths than even 7000 or 8000 ft. before the bottom of the great synclinal basin of the Witwatersrand is reached; and, beyond that point, the beds must still continue until they rise to form the southern lip of the basin, known to exist beyond the Vaal River. On the previous page we give Mr. Hatch's map of the outcrops.

Mining at Sudbury. — In the *Engineering and Mining Journal* for June 17, Walter R. Crane describes the method of mining the nickeliferous veins at Sudbury, Ontario. The veins are wide and lenticular, and dip steeply. Dry-walling is used, and waste filling is drawn by rilling from exhausted stopes to be used again below. He makes a comparison between the methods and those adopted at the Lake Superior copper mines, taking the Trimountain as a type of the latter.

CURRENT LITERATURE.

Tunnel Driving in the Alps.—At the June meeting of the American Institute of Mining Engineers, W. L. Saunders, of the Ingersoll-Rand Company, presented a lengthy paper on the driving of the Loetschberg tunnel in Switzerland.

Supporting Mine Roofs.—*Mines and Minerals* for July gives a report on tests of various methods of supporting mine roofs, undertaken by Messrs. Connor, Griffith, and McKibben, while studying the subsidence problem at Scranton, Pennsylvania.

Sea-Transport of Iron Ore.—At the July meeting of the Institution of Naval Architects, J. Johnson read a paper on the steamships and port facilities provided for the export of Swedish iron ore.

Riffles on Concentrating Tables. — In the July *Bulletin* of the American Institute of Mining Engineers, S. A. Krom questions the value of riffles on concentrating tables, and describes the table invented by U. S. James that employs no riffles at the top end.

Specific Gravity of Pulp.—*Mines and Minerals* for July reproduces a paper by F. B. Hyder, read before the Colorado Scientific Society, describing methods of calculating the specific gravity of slime-pulp and dry slime.

Errors in Sampling. — In the *Engineering and Mining Journal* for June 24, Louis D. Huntoon discusses the errors likely to arise in the preparation of the assay-sample from the bulk sample. He finds that, just as in producing bulk samples, the richer parts go into the fine, so that the return of oversize on screening must be carefully managed, in fact it is best that screening should be avoided. The material should be continually mixed after each operation, and self-discharging riffles of the Jones type should be used.

Continuous Cyanide Process.—In *Metallurgical and Chemical Engineering* for July, John E. Rothwell submits a proposition for making the slime treatment process continuous by eliminating the filter-press and effecting the removal of the gold solution and the subsequent washing of the slime by means of a series of pulp thickeners, with the cyanide solution commencing with the last, and passing step by step up to the first in the opposite direction of the flow of the slime itself.

Metallurgy at Liberty Bell.—In the *Mining and Scientific Press* for June 24, Charles A. Chase describes the modern cyanide plant at the Liberty Bell mine, Telluride, Colorado.

Metallurgy at Komata Reefs.—In the *Mining and Scientific Press* for July 1, S. D. McMiken describes the cyanide practice at Komata Reefs, New Zealand, where Brown & McMiken agitator vats (called 'Pachuca tanks' in America) were first applied.

Lead Smelting in Missouri.—*Mines and Minerals* for July contains an article by Lucius L. Wittich describing the new smelter erected at Webb City, Missouri, for treating high-grade galena by the Scotch hearth.

Symons' Crusher.—In the *Engineering and Mining Journal* for July 22, A. H. Reed describes a crusher for jig middlings, invented by Symons Brothers, in which the material is comminuted by means of rotating discs.

Wood Tin.—*The Mineralogical Magazine* for May contains a paper by J. H. Collins describing several specimens of wood tin from Cornwall and Mexico.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be supplied on application to The Mining Magazine.

BOOKS REVIEWED

THE WITWATERSRAND SYSTEM. By W. E. Bleloch. pamphlet and map. London: E. Marlborough & Co. Price 42s. For sale by *The Mining Magazine*.

It is a fact worthy of note that all those banket beds which have been proved to be important were discovered early in the history of the Rand and that in spite of much search no other beds containing similar gold contents have been found since. The Main Reef series in the Central Rand; the Van Ryn in the Eastern Rand; the Nigel Reef in the Heidelberg district; the Randfontein, the Botha's, and the Battery Reef series in the Western Rand; the Buffelsdoorn and others in the Klerksdorp district; and the Rietfontein series lying by itself to the north of the Main Reef series, were all discovered quite early and no other line of banket of comparable value has been discovered since. At the same early stage the several other horizons of poorer banket principally above, but also below, the Main Reef series became known, and it may be said with regard to such beds also that no important later additions to their number have been made. Not only did the early prospectors discover so much, leaving, as events have turned out, their successors so little reward outside of that which might come to them from the development of the initial discoveries, but in the same noteworthy manner the early geologists and engineers put together the framework of the structural geology of the field upon which their successors also have been content to build.

The work done since those days has bridged many of the early gaps upon the surface; has established the continuity in depth; and has put together such a record of structural geology and stratigraphy as will afterward doubtless be referred to as classic. From the time in the year 1886 when gold was first discovered in the banket beds, systematic and most effective search went out to the east and west of the point of discovery. So keen was this search and moved by so much impetus that breaks in the surface continuity were spanned, each extension becoming the index to the one further ahead. Then when the breaks became too big, giving the Main Reef series space to change beyond recognition, the quest was still continued, using the trend of the enclosing sedimentaries as a guide, until in the end the encircling traverse became complete, east returning to the starting point through west, and west through east. It was then that the position became reviewed, and that ideas concerning the correlation of the different beds to one another shaped themselves slowly, unforced, and in conformity with reason. Among other determinations accepted was the one that the Van Ryn series in the east was the continuation of the Main Reef series of the centre, this dignity falling to the former because, being found within the line of search, it contained important resources in gold and was of banket identical in appearance to that of the standard series. All the work done since then and all the observations made have confirmed this correlation, in which confirmation the gradual lessening of the gap between the workings on the two series has been the most important factor. This gap, caused by a thickness of more recent beds upon the surface, has given way before the advance of underground work and the probing of diamond-drills, till, in spite of local disturbances, the terminals have been so joined that there exists in the mind of most responsible persons today no doubt of the correctness of the identity of the two series.

Mr. Bleloch in his geological map of the Southern Transvaal and in the short treatise, 'The Witwatersrand System,' which accompanies it, questions and refuses this identity, affirming at the same time that the Van Ryn series is a continuation of the Rietfontein series. It was of course open and still is for anybody to bring forward and submit data that might bring the acceptance of this position into question, and, in doing so, to leave the community his debtor, always provided that proper respect were paid to the effort and the intelligence of previous workers. There is however very little of submission in the way that Mr. Bleloch has put his ideas forward, nor does he show a proper regard for the opinions of those geologists who have studied the same ground; he alone therefore would be to blame if his views were rejected with scant consideration.

Before weighing his views it is necessary to know the position generally assigned to the Rietfontein series. It was long held that this was a banket bed at a definite horizon in the lower portion of the Witwatersrand system, but during recent years this view has been questioned, more particularly by Hatch and Corstorphine, who state that this series has certain resemblances to the overlying Elsburg series, which again they considered to be in all probability uncomformable to the beds of the Witwatersrand system. Mr. Bleloch, in affirming the identity of the Van Ryn series with the Rietfontein, assigns to the latter at the same time a definite horizon in the above-mentioned system, the horizon in fact which according to general opinion is occupied by the Main Reef, a view that compels him to place that series a good step higher in the system. It is in this manner that he would prove that in the place of one there are two important reef-horizons in the system, a fact which he thinks should provide all the encouragement necessary for greater and renewed activity in prospecting.

Before however such further prospecting is justified, it has to be considered that that which has already been done leaves small hope of any extent of valuable reef along a possible second horizon remaining undiscovered, and that for this reason the encouragement from theoretical considerations must be better based than would be the case if the previous work in that direction had not been so thorough. Unfortunately, though it is claimed that the views in the treatise under review are built upon many new facts, these new facts do not stand out clearly, and the bare statements consequently carry but little conviction.

These statements, for whatever they may be worth, Mr. Bleloch bases primarily upon the pronounced appearance in one section of the Central Rand of an additional bed of quartzite between the Main Reef series and the Hospital Hill Quartzites, and he states that along any normal line of section the Rietfontein series and its overlying reefs occur in conformable position overlying the Hospital Hill quartzites, this being evidenced, according to him, in the line of section mentioned above, by the banket beds on Langermans Kop, which he says belong to the South Rietfontein series. It is, however, held by all the geologists who have studied this line of section that this additional bed of quartzite is but a duplicated outcrop of the Hospital Hill quartzites, this view having first been presented by Walcot Gibson and afterward by Hatch and Corstorphine, who explained that no duplication of the Main Reef series had occurred at the same time because the fault which was the cause of this disturbance did not reach that reef series but changed its direction somewhat to run parallel with it. This view has again lately been put

forward in the most convincing and scholarly manner by E. T. Mellor in a paper read before the Geological Society of South Africa and entitled 'Some structural features of the Witwatersrand System of the Central Rand with a note on the Rietfontein Series.' As Dr. Mellor is one of the geologists on the staff of the Geological Survey and his paper was read by permission of the Minister of Mines, there seems little doubt but that it indicates what will likely be the official view of the question. In that paper also Dr. Mellor gives some facts about the occurrence of the Rietfontein series and that on Langermans Kop, from which it appears more than likely that these two occurrences of banket are rightly correlated, as they had previously been, with the Elsburg series, and that where they are now found they lie unconformably to the beds of the Witwatersrand system, in which they can therefore occupy no definite horizon.

Between the reasoning of the geologists mentioned and the affirmations of Mr. Bleloch there can be no ground for hesitation; the reasoning and the general view will remain while the affirmations of Mr. Bleloch, which form the basis of his arguments, must go. It may also be said that even if Mr. Bleloch's reading of the lower horizons of the Witwatersrand system had been correct, the other evidence based upon the identity of the overlying reefs and upon the characteristics of the two series themselves, would remain invincible to arguments that would place the Main Reef and the Van Ryn series at different horizons.

S. J. TRUSCOTT.

GOLD COAST PALAVER. By Louis P. Bowler. Cloth, small octavo, 180 pages. London: John Long. Price 2s.

The author of this book has seen much life in Africa and North America and has been engaged in diamond-washing, gold-digging, trading, rubber planting, and other occupations dear to the adventurous spirit. He was in the first crowds at Barberton and Johannesburg, and was at Bulawayo when Lobengula granted the concessions that formed the foundations of the Chartered Company. It is of interest to note also that he prepared the first prospector's map of Matabeleland. For the last eight years he has spent much time in West Africa, and this book gives in a pleasant and chatty style his impressions of manners, customs, trade opportunities, and a hundred and one other interesting features of jungle life. His accounts of native superstitions, with conversations in the vernacular, show his observant mind, and his descriptions of insect life are both vivid and humorous. Though the book is not exactly an authoritative treatise, it is eminently readable.

CRYSTALLOGRAPHY AND PRACTICAL CRYSTAL MEASUREMENT. By A. E. H. Tutton. Cloth octavo, 960 pages, with many illustrations. London: Macmillan & Co. Price 30s. For sale by *The Mining Magazine*.

It is impossible to do justice to this book within the limited space at our disposal; even an enumeration of the headings of the fifty-five chapters would fill one of our columns. The author has the rare ability of making advanced science seem simple, and of discussing profound problems with ease and dignity. The consequence is that a student or engineer with only a general or elementary knowledge of the principles of mineralogy and optics can follow the author without difficulty and pursue his studies in every possible branch of the science. Those who were repelled years ago by the empirical methods of crystallography will find the more recent theories most attractive and indeed comforting. Incidentally we may say that the author does valuable service in presenting clear accounts of the theoretical studies of Continental scientists that have been a sealed book to many because of their publication in only the German and Russian languages. The most notable are the researches and theories of Von Federow of St. Petersburg. An interesting subject is that of liquid crystals, that is, the assumption of definite crystalline shape by one liquid suspended in another; this phenomenon may eventually be an aid in the study of magmatic segregation. Other parts of the book of interest to the economic geologist are those relating to the optics of internal reflection of light, and to the detection of internal strains. These are of value in the study of the origin and history of rocks, fillings, and veins, especially as to their paragenesis. We recommend the book to our scientifically-minded readers.

MODERN PRACTICE IN MINING. Vol. IV, Ventilation. By R. A. S. Redmayne. Cloth octavo, 250 pages, illustrated. London: Longmans, Green & Co. Price 6s. 6d. For sale by *The Mining Magazine*.

In our issue of October 1909 we gave a notice of this series of books on mining prepared by R. A. S. Redmayne, lately professor of mining in Birmingham University and now Chief Inspector of Mines for the United Kingdom. Mining is a big subject and cannot be adequately covered in one book. Several encyclopedic works have recently been issued dealing with all branches of operations, and they are published in many volumes, which are not sold separately. Mr. Redmayne's series is an exception, for each volume is a book by itself and is sold as such; for this reason they should be readily saleable. Since originally referring to the series two years ago, we have also reviewed another volume on shaft-sinking. The third volume now issued deals with ventilation, a subject which is receiving increased attention in metal mines at the present time. The scope of the book is determined by the application of ventilation methods to coal mines and the reference to the requirements of metalliferous mines is scant. In fact, Mr. Redmayne contents himself with two short extracts from contemporary literature, one on the Comstock taken from the paper presented by G. J. Young to the American Institute, and the other on the East Rand Proprietary by Sydney Penlerick, read before the Chemical, Metallurgical, and Mining Society of South Africa. However, as the book contains so much useful information applicable to all ventilation problems, it will be of service to managers of metalliferous mines.

THE MINING INDUSTRY OF MEXICO. No. 1, Hidalgo. Compiled and edited by F. Gonzalez, A. Grothe, and L. Salazar. Quarto, paper covers, 76 pages, with many illustrations and working drawings. Mexico City: Vda de Bouret. Price 2s. 6d.

This is the first number of a series of 20 volumes that has been undertaken, with the assistance of the department of Fomento of the Mexican Government, for the purpose of supplying reliable first-hand information concerning present Mexican mining and of the prospects of further expansion. This number deals with mines in the State of Hidalgo and it contains a vast amount of information about Pachuca and Real del Monte, with maps showing the claims, topography and geology, photographs, and plans and sections of mines. The editors are well known mining engineers and metallurgists, and they may be expected to produce a most valuable series of records of the Mexican mining industry.

COMPANY REPORTS

Kyshtim Corporation.—This company was formed in October 1908 to acquire the share capital of the Kyshtim Mining Works Company which owns and operates iron mines, gold and copper deposits, and timber land in the Perm government in the Southern Ural. It was promoted by the Perm Corporation. Details of the various interests and arrangements were given in an editorial article in our June issue. R. Gilman Brown is consulting mining engineer, Walter G. Perkins is consulting metallurgical engineer, H. H. Knox is advisory consulting engineer, and Leslie Urquhart is general manager. H. W. Turner has been engaged to make a geological examination and survey of the copper deposits. The report now issued covers the year 1910. During that time 89,509 tons of copper ore averaging 3·38% copper was mined chiefly from the Koniukhoff mine. The production was 1674 tons of blister copper, containing 2578 oz. gold and 22,272 oz. silver. Subsequent information shows that from January 1 to June 10 of this year the production was 1712 tons copper. Until November, smelting was done at the old plant, and in that month the first new blast-furnace at Karabash started operations, followed by No. 2 in March of this year. Two basic-lined converters have also been erected. There is a small Siemens-Martin reverberatory at Kyshtim to treat the fine ore and flue-dust, but it is now planned to build a new reverberatory at Karabash. The whole of the copper is electrolytically refined on the spot. The copper ore reserve was calculated in June at 1,500,000 tons averaging 3½% copper. As regards the financial results for 1910 of the Russian company, the profit of the copper works was £64,335, of the iron-works £23,260, of the timber department £37,371, and in addition, the sale of pyrite for sulphur content, income from gold gravel production, and other small items, brought the total receipts to £135,882. Against this £55,517 was debited for general expenses, taxes, and interest on loans from banks, and £38,256 was paid as interest on mortgages. The amount paid to the credit of the Kyshtim Corporation was £31,579. The accounts of the Kyshtim Corporation show receipts £33,310, out of which £19,523 was paid as interest on £362,500 of 6% debentures, £5000 was paid as directors' fees, £2856 as managing director's remuneration and office expenses, and there were other expenses reducing the credit balance to nothing. During the year, £12,500 of new debentures were issued, and since then a further £37,500 have been issued; by this means £37,750 appearing in the balance-sheet as loans has been repaid. The capital advanced during the year to the Russian company for the purpose of erecting the new copper-smelting plant and for prospecting was £155,760.

Troitzk Goldfields.—In our issue of August last year we gave a résumé of the history of this Siberian gold mine and recorded how, after early financial trouble, work was reorganized by Hooper, Speak, & Feilding. A new treatment plant was erected and much prospecting work was done under the direction of their resident partner, H. C. Bayldon. The new mill started work in August 1909 and work was continuous until May 25 of this year, when a fire broke out in the Stanley shaft and not only caused the mouth of the shaft to collapse but ruined the hoisting plant, pumps, and air compressors. This calamity has hastened the crisis which was impending owing to the inability of the mine to pay its way, and a scheme of reorganization has been prepared for the purpose of refunding the loan of £58,000 advanced by the parent company, the Siberian Proprietary, and of raising £45,000 further working capital; 104,993 priority shares of £1 each are being offered at par to shareholders, entitling the holders to 90% of the distributable profits each year. Six months ago, Mr. Bayldon had submitted a report suggesting various improvements. One trouble was that suitable labour is scarce and it was proposed to take steps to collect a settled mining population. Other propositions were to suspend milling for a few months in order to press forward development work, and to provide additional cyanide plant, especially for the treatment of slime. The directors last month proposed and the shareholders have approved that this new work shall go forward. The report for 1910 shows that Chilean mills treated 40,621 tons of ore and that 8257 oz. was extracted by amalgamation, 1476 oz. recovered by cyaniding sand, and 469 oz. recovered by cyaniding concentrate, making a total of 10,202 oz., an extraction of 79% of the estimated content of the ore. The receipts from the sale of gold were £42,930, and the cost, including interest on loans, depreciation, and development redemption was £52,359. The ore reserve on December 31 was given at 40,400 tons averaging 7½ dwt. Owing to the lenticular shape of the orebodies it is not possible to give close figures in the estimate.

Orsk Goldfields.—This company is also a subsidiary of the Siberian Proprietary, and we gave a lengthy account of its history and the nature of the business in our issue of August last year. The report for the year 1910 now issued does not contain much further information. It will be remembered that after the gold mining properties at Orsk in Western Siberia had been proved valueless, a placer property was acquired near Nicolaievsk at the mouth of the Amur river. A modern dredge was ordered from New York. Owing to a collision outside New York harbour, the despatch of the dredge was delayed and it did not reach Siberia before the winter commenced in November last. Consequently it has had to remain idle at Vladivostok harbour during the winter. It is now being erected and should be at work before the end of the summer, under the superintendence of C. H. Munro. As already recorded in the Magazine, the delay in getting the dredge to work caused financial embarrassment and it was necessary in January last to offer 100,000 priority shares of £1 each to the shareholders; of these 80,000 were underwritten by the Siberian Proprietary.

Burma Mines.—This company was formed in 1906 to acquire ancient silver-lead mines and slag piles at Bawdwin, Upper Burma, not far from the Chinese frontier. Bewick, Moreing & Co. are the general managers, F. A. Govett is chairman, and H. C. Hoover is on the board. The mines had presumably been worked for silver only in earlier days, judging by the fact that enormous amounts of slag averaging 45% lead are found scattered around on the surface. The Chinese miners had confined their attention chiefly to the carbonates, though there is evidence that they also treated the sulphides. The company has been collecting the slag and shipping it to Mandalay to be smelted. This involves high cost of transport, and in other ways the circumstances have militated against financial success. A year ago we reported that the results for 1909 had left the company with an adverse balance of £123,201, and that a drastic reorganization and writing down of lost capital was necessary. The capital was reduced from £355,589 in £1 shares to £78,011, divided into 312,046 shares of 4s. each, of which 286,568 carry a liability of 2s. There are also £149,188 first debentures and £34,130 interest accrued, and £30,410 second debentures. The report for 1910 shows that 28,772 tons of

slag, averaging 46% lead and 1·8 oz. silver, was smelted, together with 500 tons of ore from Bawdwin and 3503 tons of purchased ore. The receipts from the sale of the metals were £160,918, less £31,338 freight and realization charges. The cost of transport from the mine to the smelter was no less than £43,007. After payment of all expenses and making allowance for depreciation, the balance of profit was £9034. The directors mention that the slag piles are limited in extent and that they will be exhaused in about 18 months from the present time. Active prospecting and development work is therefore being prosecuted at the mines. An important discovery has been made of a lode 6 ft. wide, assaying 8% lead, 5% copper, 33% zinc, and 19 oz. silver. At the meetings of shareholders held last month various resolutions were passed consolidating the debentures. It was announced that more favourable terms of transport by railway had been obtained, and that at the present time it is impossible to proceed with any scheme of transferring the smelter to the mine.

Burma Ruby Mines.—This company was floated 22 years ago by the Rothschilds to consolidate the ruby and sapphire mines at Mogok, Burma. The expectations of big profits were never realized, and the shareholders have received small returns and have suffered loss of capital. More money was required than was expected, for the provision of water-supply and for plant. The rent and royalty demanded by the Indian Government have been oppressive, and of recent years the unpopularity of corundum and spinel stones has seriously checked the income from sales. Not only is the demand in Europe small, but the price has dropped 50% as compared with 10 years ago. Most of the sales are now made locally and not in the London and European markets. The directors do not mention the subject, but no doubt the production of artificial rubies and sapphires by the process described in our June issue will seriously affect the market for the natural stones. The report for the year ended February 28 shows that 1,466,136 loads of earth were washed at a cost of 7½d. per load, and the sales from stock were £12,666 in London and £38,522 in Burma, a total of £51,189. The stock on hand on February 28 was valued at £56,809. The profit for the year was £1090, and the royalty paid to the Indian Government was £8852. The Government has remitted arrears of royalty amounting to £4713, but declines to forego £19,228 unpaid rent and royalty, though it takes no steps to press for payment.

Associated Gold Mines of Western Australia.—It will be remembered that this company, owning the Australia leases at Kalgoorlie, arrived at a critical period of its history eighteen months ago, when it was discovered that the sampling of the reserve was wrong, the content being found to be nearer 6 dwt. than 10 dwt., as previously supposed. Up to that time the mine had done well and had yielded gold worth £2,893,226 from 1,037,955 tons of ore. The consulting engineer, E. H. Liveing, made suggestions a year ago for future work ; and since then the manager, George M. Roberts, has resigned, and Duncan F. McAulay has been appointed to the position. The report for the year ended March 31, 1911, now issued, reflects the present position, for though a profit of £22,897 was made, the whole of this and more has been allocated to the cost of development and diamond-drilling, so that for the first time since 1903 the shareholders are without a dividend. During the year 105,238 tons of ore was sent to the mill, where 34,499 oz. gold worth £146,624 was recovered, or 27s. 10d. per ton. The total expenses were £123,786, in addition to which £3923 has been charged for diamond-drilling and £24,761 for development work. The engineers do not give any estimate of ore reserves, though they consider that there is sufficient to keep the mill going for three years. Since the end of the financial year, conditions have improved as, owing to the provision of additional plant, it has been possible to mine and treat more ore. The June figures were: ore 10,041 tons and yield £15,372.

Broken Hill Block 14.—This is a small mine situated between the Broken Hill Proprietary and the British Broken Hill, and has been worked since 1889. For some years past the only work done has been the removal of carbonate ore left behind in the upper levels. In 1905 the sulphide tailing heaps were sold to the Zinc Corporation, and during 1910 some of the low-grade sulphide was mined for the benefit of the Murex Company, whose engineers were testing this process on the spot. The report for the six months ended March 31 shows that 10,753 tons of carbonate ore averaging 31% lead and 18 oz. silver was mined and shipped. This ore was fully 3 oz. richer in silver than any that has been recently mined. The cost of mining this ore was 22s. 1d. per ton and the income from its sale was £26,241. It has been possible to distribute £1500 on the preference shares and £10,000 on the ordinary shares. As regards the carbonate ore supply, the engineer, H. Voss Smith, reports that new bodies are being continually discovered in the old workings, and though no definite estimate can be made, the probability is, judging by the extent of ground still to be tested, that an income from this source may be expected for a considerable time. As regards the Murex process the directors announce that it has not been found applicable to the ore. Altogether 1521 tons of sulphide ore was mined for the purpose of testing the process, averaging 12% lead, 8¾% zinc, and 9¼ oz. silver. In the last continuous run of the plant 661 tons of ore was treated assaying 12% lead, 8¼% zinc, and 8⅜ oz. silver, and 185·6 tons of concentrate was produced, assaying 31% lead, 21% zinc, and 19⅜ oz. silver, being an extraction of about 72% of the lead and zinc and 64% of the silver. The other part of the Murex process, namely, the separation of the two sulphides, has not been a success so far, but experiments are still being made. The directors have therefore decided to take other steps for the beneficiation of the large amount of sulphides still in the mine, the proved reserve containing about 220,000 tons, and George Weir, the manager of the North Broken Hill, has been asked to examine the mine and the mill, and to make suggestions as to the best course to pursue.

Broken Hill Block 10.—Operations of this mine during the half-year ended March 31 have been hindered by a shortness of skilled labour and only 48,754 tons of ore was mined and milled as compared with 53,025 tons during the previous half-year. A year ago a break in the work was caused by the coal strike. Since the beginning of the present year the wages have been considerably higher, but the total cost will not be appreciably raised, because many labour-saving devices have been installed, especially in the hauling gear in the mine and in the method of transporting the material at the concentrating plant. The assay of the ore treated during the half-year was 12½% lead, 15⅜% zinc, and 12⅓ oz. silver ; 647⅞ tons of lead concentrate was produced assaying 62⅜% lead, 6⅞% zinc, and 37⅓ oz. silver. As regards the zinc tailing, it will be remembered that a year ago an Elmore plant was erected, but that within a few months it was dismantled, because the directors considered that the more profitable policy would be to sell the tailing to

the De Bavay Company. Accordingly 42,084 tons has been delivered in this way during the half-year at a price of 5s. 3d. per ton less 2½% commission; the assay was 4·4% lead, 15·9% zinc, and 7 7 oz. silver. The company still receives an income from the sale of accumulated tailing, and £64,978 has yet to be received from this source. The accounts for the half-year show receipts £50,589 from the sale of current tailing, and there are credits amounting to £35,932 on account of old tailing. The expenditure was £69,345, including taxes and allowance for depreciation; £10,000 was paid as dividend, being at the rate of 1% on the capital £1,000,000, and the remainder carried forward. The manager, V. F. Stanley Low, gives details of development work done during the period on the 1615 ft. and 1715 ft. levels. At the former the orebody was found to be narrow and it eventually nearly disappeared. The contents of the ore varied considerably, but the average was fairly good. At the latter level the orebody is 20 ft. wide, with a rather low average assay. As the lode is similar in appearance to what it was on the 615 ft., 815 ft., and 915 ft. levels, there is encouragement to expect better quality ore as the work continues. At the two other properties recently acquired, namely, the Rising Sun and the Comstock, disappointing results have been obtained. No more prospecting is to be done at the latter, and it is now in the hands of tributers.

Consolidated Gold Fields of New Zealand.—This company was formed in 1896 to acquire properties in the Reefton district of New Zealand from David Ziman. The chief mine operated by the company is the Wealth of Nations; the Progress and Blackwater mines were floated as separate subsidiaries in which the company holds a large proportion of the share capital. The report for the year 1910 now issued shows that the Wealth of Nations mine continues to open up well and in June of this year the mill was increased from 20 to 35 stamps. During 1910, 21,363 tons of ore was treated in the 20 stamps, tube-mill, and cyanide plant, and gold worth £36,385 was recovered. The working cost was £19,704. On December 31 the ore reserve was estimated at 25,944 tons, averaging 49s. per ton. The Golden Fleece alluvial property belonging to the company was worked by tributers and the company's share of the yield was worth £2156. The dividends received from the two above-named subsidiaries, together with other receipts, brought an income of £22,696, making the total income £61,169. The total cost at the mine and in London was £23,284, and £12,160 was written off for depreciation. The dividend absorbed £24,237 being at rate of 10% on the issued capital. The company also owns interests in the Kotuku Oilfields Syndicate and in the New Zealand Crown Mines. In September of last year the manager, E. W. Spencer, resigned, and he has since been succeeded by A. Winter Evans, recently assistant manager of the Simmer Deep.

Progress Mines.—As recorded in the preceding paragraph this company is a subsidiary of the Consolidated Gold Fields of New Zealand and was floated in 1896. In our issue of October last year we mentioned that the mine has not been yielding as much ore during the last two or three years as formerly and the whole of the 65 stamps are not always employed. The developments during 1910 were more satisfactory than during 1909. The tonnage treated was 50,202 as compared with 35,414, and the yield was worth £73,513 as compared with £52,030. At the same time the working cost was £69,389 as compared with £46,423. In addition general expenses absorbed £5623, taxes £1944, depreciation £4404, and development redemption £5373. The company has a large holding in Blackwater shares from which a dividend of £13,019 was received. The net financial result for the year was that the income and expenditure about balanced, as was the case in 1909, but a dividend of £10,312 has been distributed at the rate of 3¾% out of the balance brought forward from 1908, a similar amount having been distributed a year ago from the same source.

Blackwater Mines.—When the mines worked by the Consolidated Gold Fields of New Zealand and the Progress Mines began to give disappointing results, the two companies acquired the Blackwater property and floated it as a separate company in 1906. The results obtained have been most encouraging and the profits go far toward providing dividends for the parent companies. Milling was commenced in August 1908 and the first dividend was paid out of the profits for 1909. The report for 1910 now issued records that 39,192 tons of ore was treated yielding bullion worth £91,253. The total revenue was £92,180, and the expenses £36,708; taxes absorbed £3370, and £1844 was allowed for depreciation of plant, while £10,000 was written off development account. The divisible balance of profit was £39,298 and £37,498 was distributed as dividend, being at the rate of 15%. Owing to the drought during three or four months of each year, it has been found advisable to supplement the Pelton water-power installation with suction gas plant. Another recent improvement has been the addition of Wilfleys for the purpose of removing sulphides after stamp-milling and before cyaniding. An extensive scheme of development is in hand so that a full estimate of ore reserves is not yet possible. The proved ore is reported at 69,000 tons, but the resources of the mine are obviously much greater, judging by current development work. The veins vary considerably in width and content, and their value is not easily computed.

Hampden Cloncurry.—This company was formed in 1906 for the purpose of developing the Hampden and Duchess copper properties situated near Cloncurry, North Queensland. It was reconstructed in 1909, and last year £100,000 of 6½% debentures were created and £30,000 subscribed. The head office is in Melbourne. W. Knox, H. H. Schlapp, and W. L. Baillieu are on the board, and Erle Huntley is general manager. The present report covers the half-year ended February 28, but later information is added. Development work has been actively prosecuted and the ore reserves increased. No ore has ever been shipped, as it has always been intended to treat everything on the spot. The ore reserves at the two mines are reported at 228,300 tons, averaging nearly 10% copper, and the prospects for further developments and discoveries are excellent. A smelter having a capacity of 125 tons per day has been erected, and it started operations at the beginning of May. Another furnace is to be provided, as also is a converter plant.

Willoughby's Consolidated.—This company was formed in 1894 to consolidate various land and mining interests in Southern Rhodesia owned by Sir John Willoughby and others. Sir John is still one of the managing directors and the control is with the British South Africa Company. Until 1910 no profit was made and for that year 5% was paid. Capital has been subscribed at various times, and during 1910, 205,054 shares of 10s. each were sold. Since the end of the year further shares have been issued in part payment for property belonging to the Matabele Central Estates Co., thus bringing up the issued capital to 1,267,745 shares of 10s. each, equal to £633,872. In

addition there are £72,300 debentures outstanding. The company operates or leases a number of gold mines, of which Queen's, Eileen Alannah, and Eiffel Blue are the most important. The first named was floated as a separate company in December, and the Eileen Alannah was taken over from the tributers in November. The gold produced from these and other properties during 1910 was worth £119,908, extracted from 65,347 tons; of this £48,462 was obtained from the mines worked by the company, of which £13,133 was profit, while £10,112 was received as royalty from the mines leased to tributers. The accounts for 1910 show also profits of £72,960 derived from the sale of investments, and £30,556 was revenue derived from land and other sources. The total receipts were £170,608 and the profit was £100,029, out of which £31,695 has been distributed as dividend and the rest carried forward. The company continues to own interests in subsidiaries, of which the Surprise and the Gaika are the most important. The Arizona claims adjoining the Eileen Alannah have been acquired and the two properties are to be floated as a separate company shortly.

Thistle-Etna.—This company was formed at the end of 1908 for the purpose of acquiring the Etna gold mine in the Hartley district of Rhodesia, together with the Thistle and six other properties. It belongs to the Rhodesia Exploration & Development Co. group; Hans Sauer is chairman, H. Ewer Jones is consulting engineer, and M. Eaton is manager. The metallurgical equipment consists of Chilean mills and cyanide plant, and operations were started in August 1908. The report for 1910 shows that 37,261 tons drawn from the Etna and Thistle mines was treated and yielded 8077 oz. in the mill and 2256 oz. by cyanide, a total of 10,333 oz. valued at £43,968, or 23s. 7d. per ton. The expenses in Rhodesia and London, together with allowance for depreciation, were £42,582. At the Etna mine four levels have been opened; at the first three the length of the profitable lode averages 900 ft., the width is about 2½ ft. and the average content is 9 dwt. Not much work has as yet been done on the fourth level, but the content of such ore as has been proved is of higher grade, averaging 11 dwt. The lode is flat, the dip being 26°, and sinking by the inclined shaft is not convenient. It is intended therefore to commence a vertical shaft calculated to strike the lode at 620 ft. vertical or 1400 ft. along the dip, that is 850 ft. lower than the fourth level. Mr. Jones has matured plans for continuing sinking at the Thistle and for prospecting and developing the other six properties. For the purpose of providing the necessary funds, the issued capital has been increased from £65,000 to £90,000 by the sale of 25,000 shares at par, and the allottees have been granted an option until the end of 1912 to purchase at par the remainder of the authorized capital, £35,000.

Antelope.—This company was formed in November 1908 to acquire gold mining claims in the West Gwanda district of Rhodesia, about 60 miles south of Bulawayo. It belongs to the Rhodesia Exploration & Development Co. group and a large part of the working capital was guaranteed by Sir Abe Bailey. Under the direction of H. Ewer Jones, extensive development work has been done, and the erection of extraction plant was properly postponed until the lode was fully proved. The report now issued covers the year 1910 and shows that the ore found in the lowest or 8th level, 720 ft. vertically below the surface, is of higher grade than that in the upper levels, the average assay being 17 dwt. over a width of 6½ ft. The indications are that the average value of the ore reserve will be thereby substantially increased. Down to the 5th level the ore reserve was calculated on December 31 at 55,000 tons averaging 10 dwt. The company has plenty of working capital and is not overloaded with promoter's shares. The issued capital is £225,548 of which £70,250 in shares was paid to the vendors, the Rhodesia Exploration & Development Co., and £155,298 subscribed in cash. In the balance sheet for December 31 last the cash resources figure at £134,643, so that the company is well able to prosecute development and erect a suitable metallurgical outfit.

Wanderer.—This company was formed in 1899 to acquire the Wanderer, Ashton, and other gold properties in the Selukwe district of Rhodesia, and production commenced in 1902. During the years 1903 to 1906 the average output was 25,000 oz. per year, but subsequently the grade became very low. In July 1909 the company was reconstructed in order to provide additional capital and to purchase the Camperdown property near-by. The consulting engineers are Percy Tarbutt & Co, and James B. Little is the manager. The report now issued covers the year ended April 30. This shows that the aerial ropeway to the Camperdown was completed in July 1910, and from that time onward ore was delivered to the Wanderer mill. The total ore treated during the year was 195,234 tons, the highest figure yet recorded; of this 108,902 tons came from the Camperdown and the remainder from the Ashton. The average assay-value was 3·09 dwt. per ton, as compared with only 1·76 dwt. the year before. The metallurgical process consists of crushing in rolls and direct cyaniding. The yield was 22,711 oz. valued at £96,446, a recovery of 2·35 dwt. per ton, compared with 1·38 dwt. per ton the year before. The profit for the year, after allowing £10,036 for development redemption, was £15,190. As the year commenced with a debit balance of £14,609, the balance of profit on April 30 was reduced to £581. During the year, 6329 ft. of development work was done, and on April 30 the ore reserve at all the properties was estimated at 424,195 tons. As the mines are fully equipped and little further expenditure on plant is required, more money will now be spent on development work. It will be seen from the figures given above that the rate of extraction is not high; experiments are being actively conducted with a view of increasing the efficiency of the plant. The directors speak hopefully of the future of the company, and probably a dividend will be earned during the current year.

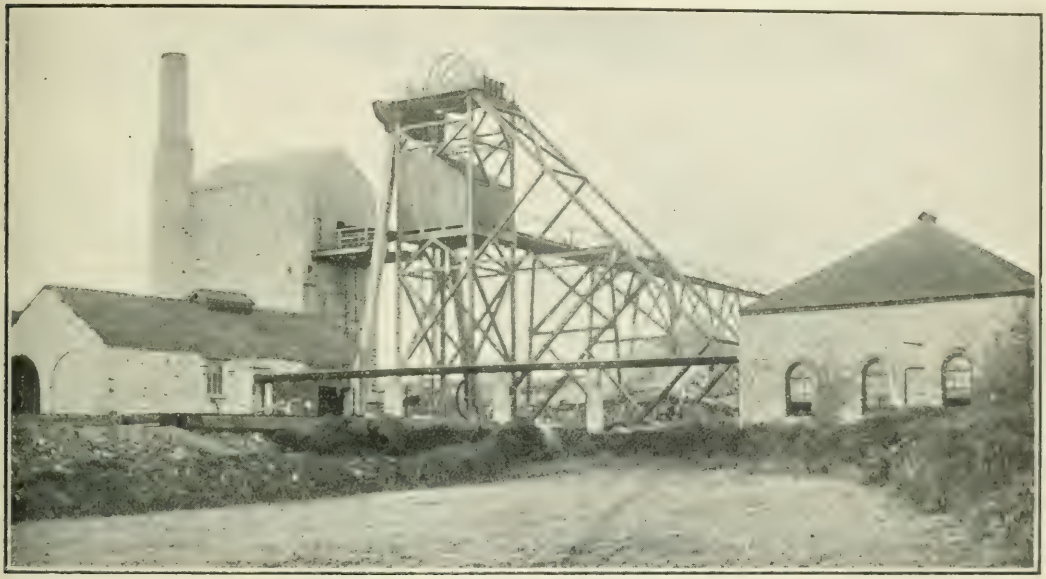
Eldorado.—The Eldorado Banket & Gold Mining Co. was floated in 1906 by the Rhodesia Exploration & Development Co. to acquire a developed gold mine situated to the north of Salisbury and Hartley, Rhodesia. The ore is refractory and the plant consists of 20 stamps, 2 Chilean mills, 8 grinding pans, and cyanide plant. Hans Sauer is chairman of the company, H. Ewer Jones is consulting engineer, and H. Stephan is mine manager. The capital is £300,000, and the dividends paid so far have totalled 75%. The report for the year ended March 31 shows that 82,802 tons was mined and milled, yielding 38,508 oz. by amalgamation and 9756 oz. by cyanide, or a total of 48,264 oz. worth £205,355, being an extraction of 11⅝ dwt. or 49s. 7d. per ton, and a recovery of 94%. The profit, after allowance for depreciation, was £92,742, out of which £90,000 was distributed as dividend, being at the rate of 30%, and £3000 was paid to directors as their percentage of profit. During the year 3003 ft. of development work was done, and on March 31 the reserve was estimated at 179,343 tons down to the 7th level, averaging 16·3

dwt. The developments on the 7th level have been excellent. Mr. Jones reports that the lode averages 21 dwt. across 6 ft. for a length of 549 ft. The shaft has been sunk to a further depth in order that the 8th and 9th levels may be opened up without delay. Cable advice shows that where the cross-cut on the 8th level has intersected the lode the ore averages 5 oz. per ton over 6 ft.

Naraguta Tin.—This company was formed in January 1910 for the purpose of acquiring tin gravel properties in the province of Bauchi, Northern Nigeria, and is a subsidiary of the Champion Gold Reefs of West Africa. C. G. Lush is consulting engineer, and F. O'D. Bourke is manager. The report now issued covers 14 months ending March 31, and shows that 551 tons of tin concentrate was won from 10 acres of land by sluicing and calabashing. The sale of this produce brought an income of £62,603, and after paying all expenses, including taxes, there was a profit of £27,161. Out of this, £17,500 has been distributed as dividend, being at the rate of 10%. The property bought by the company on flotation is 5 square miles in extent, and other tracts are now being acquired.

Wheal Kitty & Penhalls.—The half-yearly report of this company operating the Wheal Kitty tin mine at St. Agnes, Cornwall, under the direction of J. H. Collins, covers the first six months of 1911, and shows that this small mine is still giving satisfactory results. The policy has been to mine lower grade ore during the period of higher prices of the metal. The ore raised and treated during the period was 7816 tons yielding 98 tons of concentrate which sold for £11,602, as compared with 7636 tons, 110 tons, and £11,091 respectively during the previous six months. The price obtained averaged £119 per ton as compared with £100. The profit was £1875, out of which £1492 was written off for depreciation and for shaft-sinking. Dividends at the rate of 10% per annum on the preference shares and 5% per annum on the ordinary shares absorbed £841, part of which was provided out of the balance £1967 brought forward from the previous half-year. The equipment of the new Sara's shaft with pumps and haulage-gear has been completed down to the present sump, and sinking will be resumed shortly. The development covered 1691 ft. or 1 ft. for every 4·6 tons of ore hoisted. The work on or near the adit level has proved satisfactory and a lode averaging 20 in. wide and containing 33 lb. of recoverable black tin per ton has been followed for 384 ft. The prospects at the Gooninnis sett recently acquired are not particularly hopeful. In future much more ore will be drawn from the Sara's section.

Arizona Copper.—This company, with headquarters in Edinburgh, owns the Longfellow and Metcalf groups of copper mines, a smelter at Clifton, Arizona, and a railway serving the district. The usual half-yearly interim report has been issued, covering the work done during the six months October to March. The amount of ore raised was 395,577 tons, and 80,643 tons of ore and concentrate was smelted, yielding 9133 short tons in the form of blister and sulphate. The yield was 2·31% of copper per ton. The income from the sale was £460,780, and the profit was £111,150 which, together with £36,420 profit on the railway and other holdings, brought the profit to £147,570. Out of this £10,114 has been paid as income tax, £1969 as interest on debentures, £12,265 as dividend on preference shares, and £94,993 as dividend on the ordinary share capital £379,974, or 25% for the half-year. Though the price of copper was lower, the profits have not been appreciably affected and stand at about the same as during the year ended September 30 last. In addition to expenses charged to revenue account, £33,571 has been spent on new concentrating plant and on the new shaft, and this has been charged to capital. The directors report that after consultation on the spot with L. D. Ricketts, who is now their consulting engineer, they have decided to proceed with the erection of a new smelter and power-plant. James Colquhoun, the former manager, has suggested a different site from that proposed by Mr.



HEADGEAR AT SARA'S SHAFT, WHEAL KITTY.

Ricketts, and the work will not be commenced until the latter has investigated the former's proposition.

Treasury Gold.—This is a small mine on the outcrop in the central part of the Rand and is situated between the Geldenhuis and the Jumpers. During recent years it has been under Neumann control. Dividends were first paid in 1892, and continued until 1905, since which time any available surplus has been accumulated. A year ago it was found that the mine was approaching exhaustion and that it was not possible to extract the remaining ore at the rate required to keep the mill fully occupied. It happened that the adjoining mine, the Jumpers, which belongs to the Wernher-Beit-Eckstein group, was in almost exactly the same position, and it was decided to make a working arrangement between the two companies whereby from November 1 last the Jumpers should take over the management of the Treasury and pay to the latter one third of the profits derived from the joint working of the two mines. In this way it has been found possible to keep the Jumpers mill fully employed, and to extract much of the ore left in both mines in shaft and boundary pillars, etc. The report of the Treasury now issued covers the year ended March 31. For the first seven months of the year, 86,753 tons was raised, and after the removal of 26% waste, 64,230 tons went to the mill, where 19,906 oz. worth £83,398 was extracted. The working profit was £16,482. During the remaining five months, 27,828 tons was mined, and also 51,761 tons from the Jumpers, and the share of the profits due to the Treasury was £9133. On the clean-up of the Treasury mill gold worth £15,081 was recovered. After administration expenses and taxes had been paid the balance of profit for the year was £36,181, and this added to the balance brought forward from the previous year made a total credit balance of £80,328, which is being kept in hand for the purpose of acquiring other interests or properties. When the Treasury was taken over on November last, it was estimated that the available ore was 250,000 tons averaging 6 dwt.

Otavi Mines & Railway.—This company was formed in Berlin in 1900 to acquire copper-lead mines at Otavi and Tsumeb, in German South West Africa, and to build a railway from the coast at Swakopmund. The higher grade ore is shipped to Germany, and the remainder smelted on the spot, yielding metallic lead and copper matte. The report for the year ended March 31 shows that in spite of the low price of copper, and of shortage of labour, the production and profit have been fairly well maintained. The amount of ore mined was 42,000 tons as compared with 49,500 tons during the previous year; of this 31,600 tons was shipped, averaging 16% copper, 24% lead, and 9 oz. silver, and the remainder was smelted, producing 2040 tons of lead, and 2220 tons of copper matte averaging 47% copper and 26% lead. As recorded a year ago, the cost of mining went up from 11s. to 25s. per ton when underground work was commenced instead of opencut. During the past year modifications have been introduced in the method of mining, more adapted to the brittle and fissured nature of the ore, and in consequence the cost has been reduced to 23s. The business of the company also includes the administration of the railway. The total profit for the year was £224,500, out of which £85,000 has been paid to the ordinary shareholders, £65,000 to the deferred shareholders, £10,000 to the directors, and £57,800 placed to reserve.

Mond Nickel.—This company was formed in 1900 to acquire the process of extraction of nickel from nickel-copper matte invented by Ludwig Mond, whereby the nickel is removed as a volatile carbonyl compound. The Victoria mines in the Sudbury district of Ontario were bought and the matte there produced is shipped for treatment at Clydach in the Swansea valley. The copper is recovered in the form of sulphate. The first preference dividend was earned during the year ended April 30, 1904, and next year 6% was paid on the ordinary shares; the year after the deferred shares received 18%. The ordinary dividend was 10% in 1905–6, 12½% in 1906–7, 15% in 1907–8 1908–9 and 1909–10, and 16¼% in 1910–11. The share capital consists of £400,000 preference, £300,000 ordinary and £50,000 deferred shares. The report for the year ended April 30 last shows a profit of £161,544, out of which £26,366 at the rate of 7% has been paid on the preference shares, £45,906 or 16¼% on the ordinary shares, and £26,131 on the deferred shares. The progress of the company is well maintained. In order to meet the increased demand for the products, new smelting works are to be erected at Coniston, near Romford Junction, Ontario, and for this purpose an issue of £250,000 debentures has been made.

TRADE NOTES

Most of the trade publications mentioned in this column are available for distribution and the manager of "The Mining Magazine" will be pleased to secure copies for persons interested.

The British Humboldt Engineering Co. have contracted to supply two of their mechanical roasters to the Falmouth Consolidated Mines, near Truro, Cornwall. These mines yield a tin ore that contains much pyrite and arseno-pyrite, and the roasting without annoying neighbouring farmers has been a troublesome business. The provision of this new plant is part of the scheme for obtaining an efficient roast and for obviating the fume and dust difficulty.

The Sullivan Machinery Co.'s Bulletins 66B and 66C have been made up with the usual care taken by the publication department of this company and give many interesting details about hammer drills for mining work and the mountings and accessories necessary for the larger rock-drills. The company also inform us that Mr. Hart O. Berg has been appointed their representative in France.

The Stephens-Adamson Manufacturing Co. keep buyers in touch with improvements and new installations by issuing a monthly bulletin entitled 'The Labor Saver.' The July issue is just to hand and is full of interesting matter pertaining to transmission, conveying, and elevating machinery.

Werf Conrad, Ltd. have sent out additional circulars under date of July 1911 giving the latest results from their dredges working on the Tongkah Harbour and the Renong river, which should prove very satisfactory not only to the owners of the property but to the designers and builders of the three bucket dredges.

Fraser & Chalmers are agents for Amme, Giesecke & Konegen, of Brunswick, and were responsible for introducing the Giesecke Mill in Johannesburg. The recent trials of this mill at the Geldenhuis Estate have created a great deal of interest, and were referred to in our July issue.

Marcus Ruthenburg has issued a neat bulletin describing the merits of electric furnaces in the treatment of refractory ores. Mr. Ruthenburg has devoted his entire time to this subject for many years.

The Moore Filter Co. announce that they have closed a contract to equip the Hollinger mill at Porcupine with a Type A Moore Filter designed to have an ultimate capacity of 1000 tons per day.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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REVIEW OF MINING

INTRODUCTORY.—The mining market has passed through a most troublous period since our last issue appeared, every department having suffered through forced liquidation. Intrinsic values were disregarded and it may be said safely that the pendulum of speculation, which in good times goes considerably beyond the limit of merit, is at the present moment performing a reversed swing. This state of affairs is primarily due to the fact that local English and Continental holders of mining shares are easily alarmed by anything untoward in the political world, whereas, if investors were logical, mining shares would be the last holdings to be sold, as they are practically immune from the direct consequences of a European conflagration. The technical position of the market, which for many months was unique as to its soundness, has, strange to say, become worse in consequence of the continued decline in prices, because commitments that were held outside the market, against loans, with ample margin with the banks, have become doubtful and have required adjustment either by reducing the obligation or by supplying fresh margin. At the same time there is no doubt that the bear element in mining shares, particularly as regards the leading securities, has considerably increased. Provided a favourable solution of the Moroccan question is reached soon, a scramble for shares will be witnessed. It is doubtful, however, if the improvement could be maintained, as all the wreckage that has now been taken over from weak holders will have to be sold first. On the other hand, it is gratifying to observe that bargain-hunters are already making their appearance, with good reason.

The South African market was particularly upset by the mysterious fall in East Rands, followed by a nebulous explanation in an official circular. Confidence in mining ventures has been much shaken by the failure of one of the leading concerns to maintain the earnings so clearly promised by its chairman at the last meeting. It is regrettable that shareholders should have been kept in the dark as to a serious trouble, after it had come to the notice of the Board for some time past. There is no excuse whatever for the delay in acquainting the shareholders with the facts. It is evident from the circular that the actual milling and cyanide results have shown a discrepancy as compared with the assay-value of the ore sent to the mill. Being puzzled at this occurrence, the Board ordered a careful investigation to ascertain whether the assay-plan was faulty or the cyanide plant inefficient, or, as a last alternative, whether dishonesty was rampant. They were aware all the time that something was wrong, but they did not think it necessary to inform the shareholders. On the other hand, the European Committee recently found it necessary to add, to a formal notice by the Johannesburg Board, that they considered the information concerning the Cason was most favourable and highly important to the future development of this particular section. It is clear therefore that while unfavourable and alarming news, which resulted in the declaration that a reduction of the dividend would ensue, was withheld, favourable news was amplified by special observations. Thus the directors have left themselves open to the suspicion that they have used privileged information to their own advantage. No wonder that under such circumstances the public is losing confidence in group control. We refer to the matter elsewhere, and we desire to repeat a warning to shareholders, in East Rand, Prestea, and other mines under a cloud, not to be scared into a

sale of their holdings by a depreciation fully as foolish as the reckless optimism of an earlier period. They may take it from us that by the time bad news is officially given it is too late to sell, since by that time the leakage of unfavourable items has been fully used by well informed operators, who will then be on the bear side and only too glad to see the public further frightened.

The West African market has had troubles of its own, the Prestea coming under a cloud. We refer to the episode on another page. The delay in full production owing to the inability of the management to extract ore sufficient for 110 stamps has depressed the shares more than the single unpleasant fact might warrant, but it serves to emphasize the loss of confidence due to the manner in which the small shareholders are treated.

In the West Australian market the fall in Kalgurli has been pronounced. This is due to unfavourable developments on the two levels below 1650 feet and the consequent fear that the mine is bottomed; but the scare seems overdone. Likewise the Associated, with another decline, illustrates the tendency of the public to sell on a falling market and to buy at the top of a boom. This company has gilt-edged securities and a remnant of ore that together represent a sum of money in excess of the valuation given to the property, which still has some good ground worth prospecting.

Among Russian securities, Lena Goldfields were prominent by their firmness, which is partly explained by a bear account and partly by enlarged production. Now that Russian speculators have bought large blocks of these shares at boom prices they are beginning to kick because they have so little to say in the management of the mines and suggest that the head office should be nearer home, for example, at Paris. The incident bears a resemblance to the Mexico of El Oro affair. Spassky and Atbasar shares have been subjected to heavy liquidation for Paris account, but news from both properties is excellent.

Porcupine shares have been dull and lifeless.

Copper shares were weak, particularly Rio Tinto, on French liquidation, the stock being mostly held on the other side of the Channel. The decline, however, is reasonable seeing that the announced restriction of output would necessitate a reduction in the dividend; for a smaller output will not be compensated by a higher price for the metal.

TRANSVAAL.—In July the output of gold reached a new record and for the first time attained a value of over £3,000,000. This fact would have cheered the market if it had not been accompanied by discouraging labour statistics. The decrease of 5358 natives employed on the gold mines brought the total down to 181,582, as against 181,514 in July of last year. At this season the Kaffirs migrate to their kraals to do their farming and therefore a diminution of mine-workers is expected, but it was hoped that it would not prove so excessive as to wipe out the gain due to vigorous recruiting for months back. The record gold output suffered further detraction by reason of disappointing individual returns. While the total working profit on the Rand amounted to £969,687 as against £960,381 in June and £937,456 in July 1910, this small increase is not proportioned to the gross output, for a new producer, the Brakpan, is to be credited with a contribution of £13,000 in profit. A comparison with the corresponding month of last year shows an increased tonnage of ore, from 1,814,686 to 2,095,220, but the yield per ton has declined from 28s. 1d. to 27s. 2d. and the average cost has risen slightly, from 17s. 8d. to 17s. 10d. per ton, the profit averaging therefore 10s. 4d. in July 1910 and 9s. 4d. in July 1911. On the whole, it is evident that the increased tonnage of ore and greater output of gold were not accompanied by a corresponding lowering of cost; hence the final result is scarcely satisfactory.

The decrease in the number of natives employed in the Transvaal gold mines during August was 1772. This loss is less than during the previous three months, when altogether the decrease was 12,746, but it is greater than in August last year when the figure was 683. The number employed on the gold mines on August 31 was 179,810 as compared with 180,831 a year ago.

The Brakpan is a cheerful spot in Rand mining. For August the profit was £20,575, as compared with £12,600 in July. At present 100 stamps are at work, crushing 35,000 tons monthly at a profit of 11s. 9d. per ton. When the entire mill of 160 stamps is operating, the returns will justify expectations of dividends at the rate of 50% on the capital. This will enrich the Transvaal Coal Trust and Consolidated Mines Selection companies, both owning large blocks of Brakpan shares.

RHODESIA.—The July statistics are excellent, showing an output of 56,407 ounces, valued at £237,517. This is an increase of £22,170 as against June of last year. Seven more producers appear on the list. The most notable gain is that of the Lonely Reef, where the new mill has been started, treating 2940 tons for an output of £11,673 during the month under review. Slight increases are also shown by the Wanderer, Globe & Phœnix, East Gwanda, and Thistle-Etna. By reason of the July increase the total for the first seven months is better than that for the corresponding period of any preceding year.

The Shamva quarterly report suffered from an error that spoiled the authenticity of the information, but we note that in the three months ending with June no less than 226,819 tons was added to the reserve, making it 1,245,932 tons. Mill-tests continue satisfactory. Later news concerning the cross-cutting on the No. 4 adit shows 110 feet of ore containing over 8 dwt. per ton, indicating a grade above the average of that remarkable orebody. It is also reported that the two lowest levels at the Lonely Reef mine are making an excellent showing, the lode at the 7th level averaging so far 3½ oz. for 4½ feet. Water has hindered sinking. The mill has been working at full capacity since August 27.

Interest in tin prospects is lively in the Enterprise district and promising finds have been made at Abercorn and Victoria. In this case no ancient workings exist, so that the modern prospector has to dig his own holes to test the tin lodes. So far he has indulged in exuberant pegging of claims, some of which are now under option to companies likely to undertake serious work.

WEST AFRICA.—The output of gold for July is officially stated to have been 22,510 ounces, worth £91,555. This is practically the same as in June. The first seven months show a total of 134,198 oz., or 16,527 oz. more than was produced in the corresponding period last year. The Prestea did no better and no worse than in June; the same is true of the Ashanti Goldfields, which continues to be the most productive property on the Gold Coast. The Bibiani exhibits steady improvement.

We refer elsewhere to the Prestea affair, which has had a bad effect on the West African market. During the quarter ending June 30 the reserve at Abbontiakoon was increased by 133,609 tons of ore averaging 7 dwt. per ton. This is a lower content than that of the ore previously developed, as may be seen from the fact that the total reserve on June 30 was 592,191 tons averaging 10·22 dwt., but the difference is explained by the inclusion of blocks of ore previously deemed unprofitable. The Taquah mine has resumed crushing with 20 of the 50 stamps. Since July of last year when milling was suspended, the work has been centred on development underground.

AUSTRALASIA.—That there is a general belief in a period of high prices of lead and zinc in the near future is indicated by the reopening of the Broken Hill Proprietary mine.

At present the output is restricted to 4500 tons per month, only one third of that in earlier days. Important economies have been introduced at the smelter, especially in connection with the method of charging the furnaces, in order to counterbalance the recent advance in wages. The zinc-distilling plant is to be in full operation by November, the difficulties in connection with retort-manufacture having been overcome. Another interesting item of news is that by means of a modification of the Potter process it is now possible to utilize the accumulated slime. The manager, Mr. G. D. Delprat, has started for a journey of observation round the world. An intelligent guess may connect his tour with a preparatory study of the best methods of developing the iron ore at Iron Knob that has hitherto been used solely as a flux in lead-smelting.

The development of wolfram deposits promises to add an important industry to Australian mining. The deposits at Mount Carbine in North Queensland, not far from the port of Cairns, and in the district usually associated with tin, are now being regularly worked and the ore dressed in a modern concentration plant. Block 14 company of Broken Hill has taken up wolfram mining by acquiring the property of the Torrington Ore Co., at Deepwater, situated in the New England range in the northeast corner of New South Wales. This mine also yields bismuth. It has been worked on a small scale for a few years, but its ore reserve is sufficiently large to warrant operations on a greatly extended scale.

Developments at the bottom of the Great Fingall, on the new orebody, are still encouraging ; the north drift on the 18th level shows better ore than the corresponding portion of the 16th ; but nothing like the bonanza that made the mine famous has yet been found in depth. At the Lancefield an improvement in the milling is recorded, the extraction being 85%. This has hitherto been the chief difficulty.

On August 28 a gleam of sunshine fell on the Waihi, the Empire lode having been cut on the 10th level, and the first three feet of it showing ore assaying £$3\frac{3}{8}$ per ton. Of course, it is nice to hear of good ore being found on the bottom level, but it is obvious that the recent slump has not chastened the spirit of speculators in Waihi, for a couple of assays induced buying that had the effect of increasing the market price of the mine by nearly £500,000. Later news shows that the entire 30 feet of the Empire lode on the bottom level averages 54s. per ton, as against a working cost of about 20s. per ton ; but even these promising figures are of no special significance until the length of the orebody has been ascertained by further development.

CANADA.—The new company to operate in the Yukon is called the Granville Mining Co. We are informed that there was no public issue, the necessary capital being subscribed privately. The directors are Mr. F. A. Govett of the Ivanhoe Gold Corporation, Major H. L. Sapte of the Consolidated Gold Fields of South Africa, Mr. J. S. Wetzlar of the Consolidated Mines Selection Co., Messrs. William Trask, A. N. C. Treadgold, A. Chester Beatty, and H. C. Hoover. Obviously enough capital and talent is represented on the board to ensure the application of the utmost skill and experience in dredging and hydraulic mining. The capital of the company is £1,200,000. A power-plant with a capacity of 10,000 hp., with provision for a further 5000 hp., if required, has already been constructed in the Klondike valley. Mr. A. H. Rogers, of New York, is the consulting engineer and is now on the ground designing the further equipment necessary for enlarged operations.

The most interesting news from Porcupine is that relating to a discovery at the North Dome. The manager is Mr. P. Kirkegaard, a responsible engineer. The galaxy of talent that left London recently to inspect Porcupine

did not spend much time at the mines. Mr. E. T. McCarthy, however, made a reconnaissance sufficient to warrant an impression that several promising mines have been opened up. The maximum depth, not counting boreholes, is only 200 feet in the four principal properties and the showing of free gold seems to be over-worked for the purpose of booming the district. Publication of results from actual sampling of the principal workings by engineers of reputation would do much to increase public confidence. Meanwhile we hear that the Swastika district, about 50 miles from Porcupine, is coming to the front. The original discovery, now called the Swastika mine, has been worked for two years and is 200 feet deep. A small mill and compressor plant has been erected. The more recent discoveries are on the Lucky Cross, Reeves (of the Pike Lake company), and Swastika Consolidated. As is the case at Porcupine the good ore shows free gold, and if no gold is visible the quartz is usually poor.

UNITED STATES.—Our New York and San Francisco correspondents send an interesting budget of news. The former makes some interesting comment on the copper market and refers to a report on the Lake Superior mines made by Mr. J. R. Finlay as a basis for taxation by the State of Michigan. Knowing Mr. Finlay, we consider his appraisal trustworthy and of great importance to those interested in the price of copper. We also publish another article from Alaska, written by a mining engineer in whom we place complete confidence. These letters relating to mining in the northern Territory are worthy of careful reading, as we have reason to believe that the Alaska mining region, with the adjoining Canadian territory, will attract increased attention in the near future. It is a country particularly rich in gold and copper. Lack of transport facilities and severe climatic conditions have hindered rapid development, but both are being overcome. The climate is wonderfully stimulating and promotes energetic labour to a degree strongly in contrast with the malarial tracts of the tropics.

Among dredging enterprises the first place is held by the Yuba Consolidated Gold Fields, a company controlled by Boston people. Among the large shareholders, however, is the American representative of the Consolidated Gold Fields of South Africa. In the year ending February 28, 1911, the dredges of this company in California handled 13,970,728 cubic yards of gravel, yielding $2,927,246. The profit was $2,181,336, all of which, with the exception of $200,000, was distributed in dividends. The cost of dredging was 5·67 cents per yard, on gravel yielding 21 cents per cubic yard. We note also that the dredges of the Natomas Consolidated extracted $167,125 during July, as against $105,597 in the corresponding month last year. The profit has increased proportionately from $46,963 to $92,984 for the month. The yardage is not given. Last year the average yield was 9·64 cents and the cost 4·52 c. per cubic yard.

MEXICO. — Affairs have become more settled, but the labour troubles stimulated by the revolutionary outbreak are still a source of anxiety to mine managers. For instance, at the El Mayo general meeting it was stated that since the revolution it has proved difficult to get men to work in the mine, so that development has been checked. As the election for President comes in October and General Madero has been nominated, it may be expected that the new Government will be more firmly established before the end of the year, and therefore better able to cope with the situation. If Madero is not elected by a large majority, it is possible that his competitor may foment further discontent.

The El Oro Mining & Railway Co. sets a good example in issuing the resident manager's report as soon as it is received, although the document is prepared for the annual meeting at least a month later. Mr. A. F. Main pre-

sents a fine record, the working cost having been reduced to $3·90, which is an improvement of more than $1 per ton. Thus, although the assay-value of the ore was only $7·63, as against $8·86 last year, the profit was $984,333, or only slightly less than in the preceding period. The reserve of ore has been increased by 42,500 tons, to 484,139 tons. Lower cost of operation has enabled the manager to utilize the low-grade ore left in the upper workings in the days when less economical methods were in vogue.

The Torres Mines, a company registered in 1906 to acquire the assets of the Cherokee Goldfields, in Chihuahua, has been re-organized and re-christened under the name of the Ceniza Gold Mines. Funds have been provided for a resumption of work, which, the manager reports, is now practicable, owing to an improvement in the political situation.

SIBERIA.—The stacker-scow of the Orsk Goldfields is doing good work on the Pokrovsky ground, renewing the hope that the big dredge when completed will retrieve the fortunes of this unlucky enterprise. In July the Pokrovsky plant washed 24,400 cubic yards of gravel for a yield of £6000 in gold, at an operating cost of only £700. The yield therefore is again 4s. 11d. or over 1 dwt. per yard, while the cost, exclusive of administration (which is high), is only 7d. per cubic yard.

We mentioned recently that the Russian Mining Corporation had an option on the Syssert estate, near Ekaterinburg, in the Ural region, and near Kyshtim. After Mr. C. M. Rolker's inspection was finished, he asked for an extension of time, in order to do some further drilling, to test the lenticular orebodies. This request being declined, the option expired; whereupon an offer was made by Mr. L. Urquhart for the Perm Corporation, the parent of the Kyshtim enterprise. This, however, was also declined by Mr. Dimitri P. Solomirsky, the controlling owner of the Syssert property. This gentleman thereupon gave the option to Mr. V. C. Pavlovsky, a solicitor at Ekaterinburg, representing a Russian group, the members of which are now settling the details of the business.

INDIA.—The development in depth from Garland's shaft at the Champion Reef continues to give good results. On the 34th level the ore is decidedly richer than on the 33rd. At several points the assays are excellent; for instance, at the end of the south drift the lode is 2 ft. wide and averages 2 oz. gold per ton. In Carmichael's section of the same mine some good finds have been made on the 38th level. From the Ooregum, where the results of development have been disappointing of late, there is some rather more hopeful news. Between the 4010 ft. and 4100 ft. levels in Bullen's section, a body of ore has been found from 4 to 6 ft. wide and assaying from 14 to 27 dwt.

CHILE.—The Braden Copper Co. is an enterprise in which some British capital has participated. The mines are situated 40 miles northeast from Rancagua, which is 60 miles southeast of Santiago. We are informed that the new concentrating mill is finished, giving a capacity of 1600 tons daily. The old mill has been re-built so as to be capable of treating 300 tons. The smelter is designed to treat 200 tons of concentrate daily, it being expected that 2000 tons of ore will yield 200 tons of concentrate. The foundations and steel building of the smelter are constructed and it should be ready in October. The converter plant will not be ready until spring. As an alternative to the smelter, the erection of a leaching plant, with electrolytic precipitation, has been begun, but preference is being given to hastening the completion of the smelter. The reserve of ore in the mine is estimated at 10,000,000 tons, averaging 2·9% copper, and it is anticipated by Mr. Pope Yeatman that when in full running order the cost of producing copper will be 7 cents per pound.

OIL.—At the end of August a number of English companies organized two years ago to operate in the Maikop oilfield received official 'recognition' from the Russian Government and thereby became entitled to civil and other rights. This comes at an opportune time, for after a tedious period of prospecting and equipment some actual results are now being obtained. Pipe-lines have been laid down and pumping of oil has begun. A low price for the product and the presence of impurities in the oil have delayed the realization of expectations formed during the boom, but a good deal of honest work has been accomplished and better days should be in store for those who contributed the capital.

ANTIMONY.—Our readers will have noticed that during the last few months the price of antimony rose suddenly. This metal is not one of wide application but it is of importance to the typefounders and to the makers of anti-friction metals. For many years the price has been low owing to the comparatively plentiful supply of antimonial ores. German metal people in February formed one of their favourite controlling syndicates, and put the price up from £28 to £34. The weak position of the syndicate was soon shown by an appearance on the market of supplies from England, France, and other parts of Europe. What broke the syndicate eventually was the attitude of the Chinese mine-owners. The syndicate was soon dissolved and the price has relapsed to its former level £28 per ton.

CORNWALL.—At the meeting of the shareholders of the Dolcoath mine held on August 26, Mr. R. Arthur Thomas made an important statement relating to new discoveries of ore between the 490 and 510 fathom levels. Previous exploration at this horizon had not been particularly encouraging, but winzes recently sunk from the eastern ends of these levels have disclosed some excellent ore averaging at least 70 lb. black tin per ton. The new shaft, on which £120,000 has been spent, is expected to be in operation this autumn, and will appreciably reduce the cost of operation.

An even more interesting meeting of shareholders was that of the Carn Brea & Tincroft. On this occasion the new manager, Mr. Edward S. King, made a remarkable impression by delivering a speech that was brimful of energy and resourcefulness. His remarks were really an indictment of the inertness that has for too long been the incubus of Cornish mining, but he said it all in such a charming way that those who might otherwise have resented criticism of past methods cheered him to the echo. We wish we had had the opportunity of publishing his remarks in full, for though he apologized for a want of fluency as a speaker, he succeeded in putting his finger in unmistakable manner on the defects of the old methods and ideas. For instance, he had found that the Cornish stamps had no bottoms; on putting in granite blocks to serve as foundations for iron bottoms he raised the daily duty per stamp from 13 cwt. to 1 ton. He is going to revise the system of contract work, and wipe out of existence the old practice of cutting the rate paid to the competent miner and increasing that of the poor hand. He pointed to the heavy cost involved in pumping in five shafts and hoisting in eight, an absurd plan for a comparatively small property raising less than 80,000 tons per annum. He also demanded that the vanning shovel analysis should be superseded by modern scientific methods, and that these should be applied throughout the various operations at every point. His expressed determination to buy his supplies in the cheapest market will act as a healthy tonic throughout Cornwall generally. As regards the future, he stated that he intended to put his house in order and make profits with the small means at his command, and not until he has proved both the mine and his own ability will he come forward with a request for new capital to provide modern machinery and plant.

STATISTICS

Stocks of Copper in England and the Continent.
Reported by Henry R. Merton & Co.

	June 30 Tons	July 31 Tons	Aug. 31. Tons
In England	55,579	53,807	52,661
In France	5,843	5,893	5,728
Afloat from Chile	1,500	2,075	1,975
Afloat from Australia	7,250	6,250	6,550
Total	70,172	68,025	66,914
In Rotterdam	7,200	7,550	7,650
In Hamburg (estimated)	10,100	10,400	10,800

American Copper Producers' Association.
In Tons of 2,240 lb.

	Production.	Deliveries			Stocks at end of month
		Domestic	Foreign	Total	
January 1911	51,650	18,785	23,753	42,538	63,591
February	49,030	22,553	20,139	42,692	69,929
March	58,273	29,500	26,375	55,875	72,325
April	52,716	23,396	27,736	51,132	73,909
May	56,679	28,814	27,669	56,483	74,105
June	55,605	27,525	31,902	59,427	70,283
July	50,075	25,438	33,429	58,867	61,491
August	56,024	26,757	31,185	57,942	59,573

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Totals, 1910	7,228,588	305,532	7,534,120	32,002,912
January 1911	625,862	25,201	651,027	2,765,386
February	585,683	24,965	610,828	2,594,634
March	649,247	26,818	676,065	2,871,740
April	638,421	29,293	667,714	2,836,267
May	658,196	27,755	685,951	2,913,734
June	657,023	27,544	684,567	2,913,734
July	679,881	29,377	709,258	3,012,738
August	682,405	31,002	713,407	3,030,360

Cost and Profit on the Rand.

Month.	Tons	Yield per ton	Costs per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
January 1911	1,865,232	26 6	17 11	10 1	930,059
February	1,712,198	28 0	18 3	10 3	874,612
March	1,960,678	28 6	17 11	9 9	949,415
April	1,926,583	27 7	17 6	10 1	971,858
May	2,002,926	27 7	17 10	9 7	956,823
June	1,986,559	27 6	17 11	9 8	960,381
July		27 2	17 10	9 4	969,687
Totals and averages for 1909	20,543,759	28 11	17 1	11 6	11,794,376
Ditto 1910	21,432,541	28 6	17 7	10 6	11,216,105

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31	183,268	8,357	9,991	201,616
February 28	189,434	8,513	9,814	207,761
March 31	193,457	8,493	10,061	212,011
April 30	194,328	8,511	10,272	213,111
May 31	190,392	8,379	10,425	209,196
June 30	186,940	8,212	10,597	205,749
July 31	181,582	8,122	11,054	200,758
August 31	179,810	8,182	11,292	199,284

Gold Output of India.

Year 1909	Year 1910	Aug. 1911	1911 to date
£2,083,901	£2,104,858	£181,124	£1,231,880

Production of Gold in Rhodesia.

Month.	1908	1909	1910	1911
	£	£	£	£
January	199,388	204,666	227,511	207,903
February	191,635	192,497	203,888	203,055
March	200,615	202,157	228,385	231,947
April	212,935	222,700	228,213	221,296
May	223,867	225,032	224,888	211,413
June	224,920	217,600	214,709	215,347
July	228,151	225,234	195,233	237,517
August	230,792	228,296	191,423	—
September	204,262	213,249	178,950	—
October	205,466	222,653	234,928	—
November	196,668	236,307	240,573	—
December	217,316	233,397	199,500	—
Totals	2,526,007	2,623,788	2,568,201	—

Production of Gold in West Africa.

Month.	1909		1910		1911	
	Oz.	Value	Oz.	Value	Oz.	Value
		£		£		£
January	22,817	91,112	17,357	70,699	15,903	66,107
February	21,403	86,210	16,976	68,469	15,179	63,081
March	23,186	93,556	17,627	71,954	16,387	67,673
April	21,491	88,071	16,363	67,069	17,237	70,880
May	25,104	100,056	16,590	68,355	24,427	96,409
June	17,340	70,561	17,194	70,988	22,555	92,174
July	17,331	70,523	15,564	58,551	22,510	91,955
August	17,766	71,614	13,921	57,713	—	—
September	18,125	72,963	11,497	47,746	—	—
October	15,957	65,813	13,341	55,046	—	—
November	17,882	73,824	14,021	57,658	—	—
December	17,570	71,332	15,042	61,737	—	—
	235,972	955,635	185,493	755,985	—	—

Production of Gold in Western Australia.

Month.	Export oz.	Mint oz.	Total oz.	Total value
				£
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
January 1911	17,463	102,035	119,498	507,592
February ,,	22,047	84,991	107,038	454,666
March ,,	12,296	93,267	105,563	448,426
April ,,	20,455	91,791	112,246	476,787
May ,,	22,076	88,952	111,028	471,615
June ,,	10,523	106,464	116,987	497,188
July ,,	15,334	97,387	112,721	478,805

Other Australasian Gold Production.

	1909	1910	August 1911	1911 to date
	£	£	£	£
Queensland	1,916,468	1,840,337	134,275*	918,085*
New South Wales	869,546	803,727	70,320	503,111
New Zealand	2,006,910	1,896,322	136,793	1,218,159
Victoria	2,897,340	2,422,700	190,894*	1,224,600*

* July figures only.

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
July 10, 1911	213¼	£25,019	£117 6 8
July 26, ,,	254¾	£28,484	£111 16 3
August 8, ,,	222¼	£25,615	£115 6 8
August 21, ,,	268¾	£30,109	£112 0 0
September 4, ,,	—	£25,262	£114 16 8

Exports of Tin and Ore from Straits and Bolivia.
Reported by A. Strauss & Co.

	July 1911 tons	Aug. 1911 tons	1911 to date tons
Metal from Straits to Europe and America	4555	4,675	[illegible]
Metallic Content from Bolivia to Europe	2332	2,308	15,313

EDITORIAL

IT APPEARS that the East Rand fiasco is due to a technical difficulty, not unknown to experienced cyaniders. For instance, a reference to the subject will be found in the report of the Rand Central Ore Reduction Co. for the year ending June 30, 1897. During the precipitation of enriched solutions a flocculent substance containing gold in association with zinc cyanide and zinc ferrocyanide was carried away because it was insoluble in the dilute liquor used. The sludge that collects at the bottom of sumps and other receptacles in and about a mill ought to be conserved and tested. In a very large mill the accumulation, however, soon becomes embarrassing, and that is why a serious loss may occur. Mere bigness is not always an advantage ; even consolidation of units has its drawbacks. The East Rand affair suggests that a mining and milling enterprise may become so big as to be unwieldy and that organization may be carried so far as to militate against efficiency.

LAST MONTH we omitted the ' Discussion ' department, owing to lack of space. In this issue we give a large instalment of letters commenting upon various articles that have appeared in our columns. Such letters are heartily welcome, for they are useful. Thus the valued article by Mr. Horace V. Winchell on ' Prospecting in the North ' has gained by the criticisms of Messrs. W. H. Emmons, Charles W. Wright, J. M. Moubray, and R. W. Brock, besides the original writer's own responses to his critics. The highly technical contribution on ' Moisture in Tube-Mill Feed ' by Mr. John W. Bell has elicited comment that has given fresh point to the first letter, which appeared in our April issue. We hope that our readers, especially the busy men who lack the time to prepare original contributions, will avail themselves of the opportunity to correct any error, to supplement the information, and to elucidate the ideas appearing in matter contributed to this Magazine. For instance, the articles on the ' Finance of a Mine ' deal with a subject having many aspects and inviting an expression of diverse opinion. The author of them will undoubtedly accept fair criticism as a compliment. We hope that this suggestion may be fruitful.

AMONG the big winnings made from mining may be cited the story of Lord Randolph Churchill's investment in South Africa. This is told in George W. Smalley's recently published ' Anglo-American Memories.' When Churchill had made his fatal miscalculation, by " forgetting Goschen," and resigning as Chancellor of the Exchequer, his fortunes were at a low ebb. Politically he was ' down and out,' as the Americans say, and financially he was in a bad way. He decided to go to Mashonaland and to do so he borrowed £5000 from his friend, Lord Rothschild. This was in 1891. That most sagacious of engineers, Mr. Henry C. Perkins, accompanied him in his travels and on their return they went to Johannesburg, after a fruitless search for something good in the country now called Rhodesia. At Johannesburg Mr. Perkins advised Lord Randolph to buy the shares of mines on the dip of the Main Reef series. So the £5000 was invested in the shares of Rand Mines, Ltd. Needing money, he soon sold two-fifths of his holding, but the remainder he held till his death, when it brought £70,000 and helped to pay his debts. For, as Mr. Smalley says, " the strain of frugality in the first Duke of Marlborough had worn itself out."

ON ANOTHER page we discuss Sir William Ramsay's lugubrious prophesies of the starvation and disaster that are to overtake Great Britain 175 years hence. Sir William has often before been inaccurate in his facts and figures, and this unscientific attitude of his mind detracts from the value of his views. His present address contains at least two errors of calculation and statement that go far to mar our confidence in him. For instance, in discussing man-power and horse-power, he quotes the case of a Bhutanese porter who could carry 230 lb. and his own weight of 170 lb. up a hill 4000 ft. high in 8 hours and asserts that the man-power is equivalent to one twenty-fifth of a horse-power. On working out the problem we find that he does injustice to the porter by 150%. The energy expended was $400 \times 4000 = 1{,}600{,}000$ foot-pounds. One horse-power is 33,000 foot-pounds per minute or 15,840,000 foot-pounds in 8 hours. The man's power was therefore approximately one tenth of a horse-power. Then again he is wide of the mark in stating that the adoption of the steam-turbine will effect an enormous saving in the consumption of coal per horsepower-hour, his figure being 4 or 5 lb. in a reciprocating engine and 1 or $1\frac{1}{2}$ lb. in a turbine. No doubt some second rate or badly managed reciprocating engines are as uneconomical as he suggests, but their number is few, and, on the other hand, it is certain that no steam-turbine ever gave 1 hp. for 1 lb. of coal per hour under practical conditions for any extended period. Indeed the steam-turbine has only a short lead on the best reciprocating engines. We cannot imagine Huxley, Darwin, or Spencer making such slipshod blunders.

PORCUPINE has received a notable recruit in the person of the Marquis of Queensberry. He left for New York on August 12, on his way to the new goldfield in Northern Ontario, and before starting he stated that if he was successful there he would send for his sons to join him. We hope he may be successful, if only to spite the fates that have been so unkind to him. Most of us are apt to associate the marquisate of Queensberry either with pugilism or taxi-cabs. Possibly Porcupine may supply associations even more honourable. Meanwhile we cannot but sympathize with his complaint that although a marquis he does not sit in the House of Lords, because his title being Scotch and he a Radical his peers do not select him to represent them at Westminster. Again, those of his Radical friends who are plebians look askance at him because he is a marquis. Was ever a man so awkwardly placed! Manifestly he has chosen well in going to a democratic country where a career is open to talent whether to marquises or market-gardeners. Possibly at Porcupine our worthy gold-miners may learn to forget that he is an ineffective marquis and give him credit for being an efficient man. We warn our Canadian friends, however, not to put the Marquis of Queensberry on the board of directors of a mining company until he has served his apprenticeship as a miner.

IN THIS ISSUE we publish another of the series of articles on mining finance. Mr. Burnham must have succeeded already in stimulating intelligent interest in a subject the technical character of which is rendered of the greatest practical importance by its application to actual practice. All his conclusions may not be acceptable, and some of them may appear to be counsels of perfection, but in these days of serious mining operations such advice is surely more welcome than the counsels of imperfection that gave so low a tone to the *moral* of mining speculation twenty years ago. In his fourth article Mr. Burnham uses the Santa Gertrudis deal of the Camp Bird company as an illustration of a risky bit of finance, especially in regard to the debenture issue. His criticism is not rendered useless by the fact that the deben-

tures have recently been retired. As regards the allowance for a persistence of the orebody for 100 feet below the deepest level and the inclusion of this block of ore in the reserve, it is only fair to say that the development of the mine has confirmed the estimate, although it may not wholly justify the risk taken by those who made that estimate. Ore not measurable is not ore that can be measured. 'Probable' and 'positive' are not the same. Certain distinctions are essential to sound business in mining as in ordinary affairs. In this case the expectations were fulfilled and the promoters have received hearty congratulations, but Mr. Burnham's point is, we take it, that the Camp Bird incident affords a dangerous precedent and is one not to be followed on its merits. We must not eliminate hopefulness in mining; without some cheery optimism the industry would shrivel and discovery would languish; but we must distinguish between the things hoped for and the things seen, lest our footsteps stray into those mirages of a superheated imagination that, on nearer approach, fade into the barren sands of disillusionment.

East Rand Proprietary.

A cablegram from the Johannesburg correspondent of *The Financial Times* anticipated by five days an official announcement that something had gone wrong at the East Rand Proprietary. A shiver of apprehension on August 29 was followed on September 2 by an explanation from the directors of the company. Results from development were poor during the quarter, therefore a rumour of a cut in the dividend was not in itself surprising and did not produce an immediate effect, but the official circular did. It appears that the amount of gold deposited by precipitation and accumulated in the zinc-boxes was found to be short of the estimate. This discrepancy, it is acknowledged, had been noticed "for some time past," and finally became so serious as to call for a special investigation by Mr. W. A. Caldecott, as an expert in cyanidation. He confirmed the shortage, and apparently was unable to suggest a satisfactory explanation. For none is given. The directors say that "the unrecovered gold will most probably be lost." This is merely cryptic. A simple and frank statement was urgently needed. The gold was either extracted in the mill and has been stolen, or it never was extracted and a radical error has been made in the calculated recovery. Such calculations are based on a series of samplings and assays. The ore is sampled in the stopes underground and the assays are recorded on a large map; the pulp discharged through the screen of the stamp-battery is likewise sampled and assayed; note is taken of the amalgam, as it is removed periodically from the plates; the gold contents of the sand and slime in the vats is ascertained; the residues from each are tested, as well as the cyanide solution that has removed most of the gold; the solution circulating through the mill is known as to quantity and gold contents; finally the tailing ejected and the water escaping from the mill are both carefully analysed. Thus by check and counter-check, by calculating forward and backward, it becomes clearly ascertainable where the gold lies and how much of it must be collected in the precipitating-boxes, which constitute the clean-up department of a cyanide plant. As some mill-assays are made hourly and others daily, at least, it is impossible that a serious discrepancy could go long undetected. The matter needs an explanation more satisfying than any yet given. We are in a position to give it.

It has been practically acknowledged that the mill "for some time past" has not yielded as much gold as was required to agree with the supposed contents of the ore, but that the difference was compensated by the gold held in reserve, in the form of zinc 'shorts,' amalgam,

current solution, with other odds and ends, large in the aggregate. Probably the management hoped to redress the error, but it became so large as to require an explanation that might obscure or minimize the damage done to the reputation of the company. Undoubtedly the absence of a satisfactory statement aroused fears that the ore being mined was not up to the grade specified in the estimate of the reserve underground, or else that the stoping width had been increased and the grade lowered by an effort to maintain the enormous daily tonnage required for the mill. But we have information indicating that the trouble can be localized in the mill; it does not concern the mine or its resources. We preface our diagnosis by explaining that the East Rand mill has been in a state of construction for three years, and that during that time the incompleteness of the equipment has handicapped operations so that the treatment has lacked the perfection desired. Before the plant was completed it was crowded with ore beyond its capacity and it has been a continual struggle to meet the requirements of the mine output. Even now the slime department is 10 vats short, so that the tonnage crushed has to be reduced from 200,000 to 180,000 tons per month. In consequence of this overcrowding of the plant it is a fact that gold has been lost in a manner not altogether accountable. The loss acknowledged is put down at £250,000.

As an explanation for the discrepancy it has been suggested that the loss of gold was caused by the 'fouling' of the cyanide solution. As a matter of fact we have reason for stating that it is due to something analogous, namely, the loss in dissolving power due to lack of aeration of the solution. To non-technical readers it may be explained that a cyanide solution that has been in contact with the crushed ore will cease to dissolve further gold after a certain time, and, instead of dissolving, it will begin to lose gold by re-precipitation. The gold thus precipitated is, strange to say, not re-soluble in the current cyanide solution, without introducing fresh solution. This gold may therefore be lost in the final tailing or it may be deposited in other parts of the mill, such as the solution and storage tanks, whence it is finally rejected. It could be, and it should be, detected, but in a plant that is being crowded it may escape through pressure of ordinary routine labour. The apparent remedy is to cease working the cyanide plant at over-capacity and to make additions such as will facilitate the aeration of the cyanide solution, for fresh oxygen will re-vitalize the 'foul' or degraded solutions so that they become again effective.

Whatever official explanation or apology may be forthcoming, the fiasco is a serious shock to public confidence. The East Rand Proprietary is one of the greatest gold mining enterprises in the world, it has been recommended as a trustee stock, it was one of the few mines worthy of being regarded as an 'investment.' It is capitalized for £2,500,000, and its market price has dropped £5,600,000 in a few months. The decreased market value represents 11s. or $2\frac{3}{4}$ dwt. per ton on the reserve of 10,000,000 tons of ore. Serious as the trouble at the mill may be, it warrants no such exaggerated depreciation. It has been our aim to lessen the perplexities of the shareholders. They must not permit themselves to be stampeded. The East Rand Proprietary is a great mining property of proved resources. Those who are real investors should sit tight. After the disclosure it is silly to throw shares on a crumbling market, thereby simply playing the game for those who have started a bear campaign. If shareholders can get news of trouble before it has had its full effect on the market, they might profit by selling their shares and re-purchasing later, but this they are rarely able to do because official statements usually appear long after bad news has leaked out. East Rand shares have been weakened

by rumours for many months. It has been known to some people " for some time past " that things were radically wrong. Now that everyone knows, it is useless for the investor to unload. He is advised to wait a slow recovery to a figure at least higher than those obtainable during a panic.

Prestea.

The information, given in our August issue, that all was not right at Prestea, has proved only too true, for on September 1, after an inkling of the facts had depressed the shares for several days, a circular was issued by the secretary of the company, acknowledging that the output of the mine could not be maintained at more than 15,000 tons per month until a new incline-shaft has been sunk and fully equipped. Thus not more than half of the total mill-supply can be delivered until at least another year has passed. The directors appear to have been unaware of the real conditions, for at the general meeting in June Mr. Edmund Davis, the chairman, stated explicitly that the 110 stamps would be fully at work by the end of the current year. The letter from the manager, Mr. E. C. Homersham, compelling this revision of the estimate, seems belated, having regard to the fact that Mr. Homersham has been in England more than a month. The episode has a sinister look. The Prestea has two working shafts; one is equipped with 5-ton skips and another with skips of 2-ton capacity. Underground there are bins capable of holding 2000 tons. Apparently there should be no difficulty in hoisting 1000 tons per day, if sufficient labour is available. The ore is from 9 to 10 feet wide and the openings extend for a length of 5000 feet. But the hard quartz lode has a casing of soft graphitic schist; this is from 18 to 24 inches thick and may lie on either wall, and sometimes on both. When moisture seeps into this casing, as it will in a damp tropical country and in a mine having many openings at surface, the ground becomes heavy and great care is required to prevent falls that impede the breaking of the ore, besides being actually dangerous to those at work in the stopes. In other words, this mine calls for skill in supporting ground and filling excavations, but presents no extraordinary difficulty. And whether this be great or small, it should have been known both to the local management and to the London directorate many months ago.

Another Cassandra.

Things in general appear to have gone wrong of late. International, no less than domestic, affairs have given John Bull a touch of the liver, and the man-in-the-street has come to the conclusion, like Mr. Mantalini, that the country is going to " the demnition bow-wows." When the Moroccan crisis and the railway strike had reduced the average suburbanite to wondering what moment was to be his next and when a sweltering summer had taken all the starch out of the most arrogant jingo, even a Last Ditcher, there comes the final stroke of malign fate in the shape of vaticinations by Sir William Ramsay, saying that our coal supply would last only for 175 years, after which we, or our descendents, must " look forward to the near approach of famine and misery." Sir William's dicta in other matters concerning which he might be expected to be fairly accurately informed have proved incorrect more than once before, and the estimates even of Royal Commissions on our coal supply have been rendered ridiculous also more than once, so that the quotation of the one by the other should impress only those too weary to think for themselves. We marvel, indeed, at the utter lack of imagination exhibited by an honoured scientific authority. A period of 175 years at the beginning of the 20th century contains more possibilities than a thousand years in the days of Job; a year of modern Europe in more than a cycle of

Cathay. In the lives of many now living such wondrous deeds have been done in the application of nature's gifts and the conquest of the energy that is stored in rock, water, and air has proceeded at a pace so accelerating that there seems no pressing need to despair of the future of the British Islands even when the coal resources are measurable. But they are not. Sir William Ramsay's premises are not to be taken seriously. He bases his facts on the report of a Royal Commission. In 1871 one of these ponderous committees estimated that by 1900 only 85,000 million tons of coal would be left; thirty-four years later, despite a doubling of the rate of output, another Royal Commission (that of 1905) estimated the visible supply at 101,000 million tons. Both of these Commissions only counted the coal above 4000 feet deep, but the second allowed that five times as much coal existed below 4000 feet as in the ground overhead. We believe that man can go deeper than any profitable deposit of metallic ore yet discovered; on the other hand, we also believe that coal strata in many parts of the world dip deeper than man will ever be able to penetrate, yet that his burrowing will be sufficiently effective to extract coal two miles below the sunlit surface. Such deep mining would open a practically illimitable supply of coal, enough to postpone Sir William's day of famine and misery to the Greek kalends. And if for the sake of argument we suppose that the coal of Britain is finally exhausted, not in 175 years, but many centuries from now, are we to stifle our imagination, refusing to see the possibilities of oil, of alcohol, of electricity, of sources of energy to be discovered by scientific research stimulated by the desire of profitable exploitation. The use of oil as a concentrated and convenient fuel has only begun, yet half-a-dozen steamers of over 5000 tons each, now on the stocks, are to be equipped with the Diesel oil-engine; petrol has displaced coal in many directions; alcohol is made from various substances and will yet be made from most of the organic rubbish of creation; electricity has not reached its limitations, especially as regards transmission from long distances. Cheer up, gentlemen! Scientific invention proceeds by geometrical progression. A hundred years ago there was a panic in England because the supply of oaks threatened to be insufficient for the building of ships. A hundred years hence our descendants will smile at our fear lest we should go bankrupt for lack of coal. Let us use it thriftily by all means, beginning at Salisbury House, where scores of wretched little grates waste as much coal as they consume. By all means let us use our coal, but with due economy. If left in the ground it benefits no one; it is our capital, truly, but it yields no interest if unused. Long before the supply is exhausted our descendants, in whom we place more confidence than the savant at Portsmouth, will have learned to use other sources of heat. Till then let us avoid the chills of a premature pessimism and the damp cold of an unintelligent despair.

The Railway Strike.

The recent crisis should arrest the attention of all thoughtful men, because it affords another illustration of the changing relations between employer and employee, between capital and labour. Those of us who have had charge of mines, especially in America and Australia, are familiar with that form of industrial paralysis called a 'strike' and we recognize that the proper understanding of men is at least as important as the knowledge of ore deposits.

The dispute originated at Liverpool, where 25,000 dock-labourers had been dismissed or 'locked out' by the leading ship-owners on August 14 in consequence of the failure of the men to carry out the terms of an agreement. Thereupon the Transport Workers Federation called out 75,000 labourers en-

gaged in the carrying trade of the port. This was followed by a strike of 10,000 railway-workers, also at Liverpool. In order further to accelerate a crisis the committees representing the four leading national railway-workers unions issued an ultimatum on August 15 announcing that a general strike on all railways would ensue at the expiration of 24 hours unless their demands were met. The railway managers declined to make any concession. On August 17 the railway service was disorganized in many parts of the country by men refusing to work. An unprecedented situation was created. Riots and *sabotage* proved that hooliganism was rampant under the cloak of labour unrest. The Government immediately called a conference of those representing the warring factions and on August 21 a provisional settlement was reached, by the promise to appoint a Commission empowered to enquire at once into the grievances that has caused the outbreak. At the same time the Prime Minister undertook to enact such legislation as might be necessary to give practical effect to the findings of the Commission. This ended the strike.

Of course, this précis of a complicated series of events gives but a bare sketch of the living energies that have been fiercely at odds. Behind the claims and counter-claims of the railway companies and the labour unions there exist conditions for which neither is wholly responsible and to which both must give calm recognition. Into these it is more profitable to enquire than into the merits of the final quarrel that precipitated the strike. In the first place, the railways are over-capitalized because they originally paid exorbitant prices for their right-of-way and then debited current improvements to capital account. As in British mining, the ground landlord has burdened a public utility with a super-tax. As in mining, development has often been charged to capital. Owing to State regulation it is not possible to levy rates, either on passengers or goods, such as will redress the balance. The railway companies pay only from $2\frac{1}{2}$ to 6%, while in America, for instance, with more expensive equipment, no better management, and lower rates, the return is from 6 to 10% on the capital invested. The only direction in which earnings can be increased is by economy, especially in labour. Hence while the cost of living has increased about 10% in the last decade the wages of railway-workers have remained stationary. Even this does not tell the whole story, for averages are often misleading. Among the railway-workers of the United Kingdom 134,000 are receiving 20 shillings or less per week, and 107,000 earn from 21 to 30 shillings per week. Overtime is usually counted after 12 hours. A holiday is granted after 10 years service. These facts appear to excuse dissatisfaction. But the men cannot complain without risking the loss even of a precarious livelihood. Hence many of them—116,214 in the principal unions—have formed organizations, the leaders of which can represent them in making complaints to their employers. On December 31 1910, the total of persons employed on the railways of the United Kingdom was 608,750; hence it is apparent that not quite 20% of them have joined the unions. But it is also obvious that this minority is sufficient to cripple the railway system and hobble the business of the country. The number recently on strike is estimated to have been 200,000. It remains uncertain whether the number would have increased or decreased if the strike had continued a few days longer. Apart from dissatisfaction due to low wages and higher cost of living, the men complained that the Conciliation Boards formed in 1907 had failed, because, among other reasons, they could not be represented by their leaders. The railway managers refused to recognize the unions or the officers of those unions. On the side of the managers it may be said that they were willing to meet their own em-

ployees but ignored the unions or any other labour representative who was not on their pay-roll. Obviously labourers are rarely good spokesmen and they also fear to appear recalcitrant, lest this should lead to dismissal or loss of promotion. Hence the desire to be represented by a skilful pleader, just as the railway companies themselves engage expert lawyers to speak for them when asking for a concession from Parliament. The refusal of the railway companies—except the North-Eastern—to recognize the unions was undoubtedly the prime cause of the strike, for while it embittered the men it angered their leaders.

Thus we come to the vital question of unionism. Is it advisable in the interest of the community at large—not the railway companies or the railway workers only—that the workmen engaged in the transport system of the country should be organized? To put it plainly: is it best for the public that these workmen should be a unit or a mob? We must recognize that the personal relation between employer and employee no longer exists where thousands are working for the agents of a stock company. A heterogeneous mass of men is working for a corporation; as aggregates neither of them has a conscience or a sense of honour, for both of these are personal qualities that disappear by multiplication. Hence the bad faith and inhumanity incidental to industrial war. The employers are organized; a company is a unit of employers. These companies co-operate and form a more comprehensive unit. Why not the workmen? We believe that it is as useless to decry unionism as it is to outlaw competition; both are logical developments of that modern way of living we call civilization. Accepting the fact that the men must tend to co-operate in self-defence and for collective bargaining, let us encourage the tendency to the point where it becomes useful by giving the State a unit that is tangible and controllable. Let both the employer and employee organize so that the contending interests are represented by responsible committees. In the interest of the public, that is, the country at large, it is desirable to end the savagery of indiscriminate strife. Let agreements be embodied in contracts secured by the giving of bonds for faithful fulfilment. Then if either side proves tricky or evasive, the issue can be tried and the culprit punished in terms of pounds, shillings, and pence. A member of a union who strikes without authorization should be liable, at least, to forfeiture of membership. At present the men are inclined to keep agreements if it suits them and break them if it does not, on the principle of "Heads I win, tails you lose." The companies accept the Conciliation Boards with a tongue in their cheek and neutralize the intent of agreements by attention to the letter rather than the spirit of them. Both do wrong and both need to be brought to heel by the State. The public is the final arbiter in these matters and the Government is the executive for the public, that is, the country, outside the parties to the industrial contract. The desire for social justice may require recognition for the workman's union as for the employer's company, but even to the least observant it is obvious that the force of any contract between the two parties is impaired by the fact that one of them has property, railways or factories, vulnerable to attack and liable to depreciation during strikes, while the other at present gives no hostage for fulfilment of his legal promise, claiming recognition for his union when working for redress of grievances but permitting that union like Pyrrhic cavalry to disappear on the horizon at the first word of retaliation for infraction of a covenant supposedly made in good faith by the two opposing interests. Both the railway companies, as an organization, and the railway workers, as a consolidated labour-union, should give surety for carrying out their agreements with

each other, and that surety should be a sum of money large enough to be impressive, with other punishment severe enough to be a deterrent. In other words, let us employ collectivism, whether of capital or labour, as a convenience for the prevention of industrial anarchy and not as a recurrent menace to civilization.

Official Valuation of Shares.

We publish a letter from a correspondent who appears to take a pessimistic view both of the mining business and of those engaged in it; yet his forebodings are relieved by a suggestion of which it can truly be said that what it loses in practicability it gains in humour. He takes it for granted that the ordinary reports issued by mining companies fail to be illuminating on the one point at issue, namely, the value of the mine as an investment. He proposes therefore that the medley of data concerning drifts and winzes, assays and drillings, prospects and reserves, shall be supplemented by an official appraisal of the mining property and an inferential valuation of the shares among which that property is divided for market purposes. Undoubtedly the introduction of such a custom would add new terrors to a directorship and might even put a wholesome fear into the hearts of guinea pigs; in any case, it would impose so serious a responsibility on the directors of mining companies as to lead to a radical change in their status. If it tended to create a demand for the professional director, that is, a man specially trained and specially qualified for such work, the innovation would receive our whole-hearted blessing. We need in mining, as in all forms of industrial enterprise, even railways, to have men at the council-board who have had the training and experience fitting them to direct complex financial and technical operations. Mere titles having a purely social significance or real distinction achieved in unrelated pursuits will some day cease to qualify gentlemen as directors of public companies; when that day comes the admiral, the general, the pro-consul of empire, will be expected to know something of mining before he is entrusted with the task of guiding a mining enterprise. Even City men of the glorified jobber kind will not be deemed the best for the purpose. When that millennium arrives, we shall see the boards of mining companies strengthened by the presence of those who accept the occupation of a director as a serious avocation for which due preparation will have been made by the systematic study of mining and finance, supplemented by an apprenticeship in these kindred branches of knowledge. That "far off divine event" is not yet. Before we ask directors to appraise mining properties we must either teach them how to do it or select men that already know how to do it efficiently. It may be granted that in some cases, as in the Kolar group of gold mines or the equally celebrated group at Treadwell, it would be practicable for the directors to give the shareholders a quarterly valuation of their property, and hence of the shares into which the property is subdivided. In these two instances, at least, the mines are well developed, the lodes are fairly uniform in character and persistence, and—what is even more important for the purpose in hand—the directors are advised by consulting engineers of wide experience and tried capacity. But all lodes are not uniform, all orebodies are not large and continuous, all consulting engineers do not hold the complete confidence of their directors. On the contrary, patchiness, perversity, and non-persistence are as characteristic of most ore deposits as mutability in man or mortality in mankind. There is too much of the x in the equation to permit a simple solution. Take the Globe & Phœnix, the Spassky, the Goldfield Consolidated, the Waihi, the Great Cobar, the Dolcoath, for example, variously rich and variously promising, and ask half-a-dozen well informed men

to appraise them : the results would be more interesting than edifying. If the best informed specialists could not make an accurate appraisal, it is at least certain that the directors could not. Before such a difficult task is put upon them it will be necessary to re-constitute the boards of most mining companies. Frankly, we like the idea. It is one to play with ; if not to conjure with. Think of the director who now traffics in shares being compelled "to give the snap away" by stating openly that the £4 shares are only worth £2, or that the £2 shares are worth £4. The privileged speculator who now sits as a director would have to distribute his information or resign from the board. The weary shareholder would skip the petty details about Level No. 6 and Winze No. 5, the bewildering array of widths and samples, the complexities of 'reduced' and 'unreduced' assays, the difference between sorted and unsorted ore ; he would have eyes only for that pregnant paragraph that told him how the wise men on the board had appraised the property on a given date at a given sum in pounds sterling. It looks too good to be true ; but it is an idea, possibly an ideal.

Assays.

At a meeting of the Balcobo Tin Mines, the chairman, Sir Cornthwaite Rason, gave an account of his visit to the property, which is in Spain. We referred lately to the unsatisfactory character of the data furnished in the prospectus. The recent meeting affords an appropriate sequel. In his speech, the chairman said : "With regard to values, I myself took three samples from the mine, which were sent to Johnson, Matthey & Co., assayers to the Bank of England, for assay." The first sample was of concentrate, in a bin ; the second came from "the lode;" and the third "was of pegmatite. Of which material there are [so said the chairman] hundreds of thousands of tons there." In each case "the produce of pure tin" was extraordinarily high, the three assays showing 62·5%, 66·5%, and 28·5% metallic tin. The weight of the samples was stated but nothing is said concerning the width of ore across which they were broken. The whole performance as narrated by the chairman was a farce, likely to mislead those who are not experienced in mining. Of course, if a mere Marquis or a bluff Admiral had been guilty of such humorously amateur work nothing much might be said and the episode might be treated as a pathetic kind of joke, but when a gentleman who was recently Agent-General for Western Australia and presumably knows a little about the rudiments of mining goes through such a performance it is proper to call him severely to account. In the first place Sir Cornthwaite Rason ought to know that it is much easier to make a correct assay, even of tin ore, than to take a sample of a lode. He ought to know that he "himself" is not qualified by experience to do so. We deprecate strongly the use of names of reputable assayers and the introduction of the Bank of England into a statement implying that either one or the other certifies to the value of the ore. They simply give a certificate proving that the material submitted to them for assay did contain a certain proportion of metal. They do not certify that the ore came from the mine mentioned, although that, of course, we do not question, or that the few pounds of stuff represented any tonnage of similar ore. The samples sent by Sir Cornthwaite Rason to the assayers were what in practical mining we term grab samples or specimens. Is the chairman aware of his responsibility when he asserts that there are "hundreds of thousands of tons" of ore averaging 28½% tin on the Balcobo property? Unpublished reports, based on inspection by engineers of high standing, indicate that such a statement is so unwarrantable as to merit severe censure. This is another illustration of the harm done by allowing non-technical

persons to guide the public in technical matters. Furthermore, it should draw attention once more to the folly of assuming that skill in politics, in diplomacy, in warfare, in gardening, or in tennis, in any way fits a man to guide the highly specialized business of a mining company.

Indexes of Technology.

From time to time attention becomes directed to the proper indexing of current technical literature. The subject has recently been brought to our attention by the completion of the first year's issue of the monthly bulletins, containing a record of articles on mining and metallurgy, published by the International Institute of Technical Bibliography, of Chancery Lane. We do not feel called upon to criticize the efforts of other publishers, or to examine in detail the value of the results achieved, except to say that though the indexes are compiled by well meaning people, they fail to satisfy either the general reader or the expert, in that they are not eclectic; in other words, the compilers are not specialists and therefore are not judges of the current or permanent importance of the articles included or omitted.

The adequate codification of technical knowledge at regular intervals is an object so worthy as to warrant encouragement, and, to that end, we think it right to define our own views on the subject. We hold that it is impossible to index all mining and metallurgical literature so as to form a complete record of knowledge and progress. It is only the specialist in some particular branch that requires such a record, and as a rule he chooses to do his own searching, and to form his own views as to the value of the respective articles. Besides, a specialist makes a point of reading everything, good, bad, or indifferent, for even a foolish article may contain points for him, and a three-line filler at the bottom of a page may prove to be an indicator of the greatest service. The specialist as a rule is well able to take care of himself, and we do not expect him to rely on indexes prepared by people who necessarily know less of his particular subject than himself. Having thus eliminated the specialist, we have only the general reader to consider. By him we mean the intelligent mining engineer or metallurgist, who, while pursuing for himself the particular study connected with his daily work, is desirous of being fairly well informed on all the subjects connected with his profession. It is on this basis that we prepare the columns headed Précis of Technology and Current Literature. The pages devoted each month to this purpose are not numerous, but we ask our readers to believe that articles not mentioned have given us almost as much time and consideration as those that receive reference. In other words, we read carefully the papers and transactions as they appear in print, and the omission to mention many that have occupied much of our time is often a useful service to the general reader. The abstracts published in this Magazine are not done by the editor's proverbial instruments, the blue pencil and scissors. They are all written by hand after the abstractor has thoroughly assimilated the subject matter, and usually they contain explanatory information in addition to that provided by the author. The work is done by those who have a direct knowledge of the subjects and are capable of forming some sort of judgment on questions incidental thereto. In twelve issues these pages reach a total of over 100, enough to form in themselves a yearbook of progress, suitable for permanent preservation.

The average indexer, having no special knowledge, usually judges the importance of an article or paper either by its length or by the beauty of its illustrations. As a rule he does not take cognizance of 'leaders' or 'editorials,' though these, if written by technical men, may contain views and pronouncements

that the general reader and the specialist would be sorry to miss. Our contemporaries occasionally publish articles relating to some new mining district, under 'scare' headings; the news may be of no value either today or a hundred years hence, but by the virtue of a prominent heading such writings earn places in the indexes prepared by incompetents.

Besides the general reader and the specialist, there is a third class of customer to whom a good index may be of use. We refer to the beginner or 'outsider' who hopes to obtain complete information on some particular subject, and usually expects to get it for "about eighteen pence." At this time of day nobody can expect to get a technical education for the price of a golf-ball. Yet useful information was never so cheaply acquired as today; the price of living has risen in every civilized country, but the cost of recorded knowledge, whether of theory or of experience, was never so low. For half a guinea the young engineer can get the recorded experience, in regard to a special subject, of a past master; for a guinea the student can purchase a compilation equivalent to a course of lectures. It is an utterly worthless volume that will not yield information equal in value to that of the retail price of the book. A book by an experienced specialist will afford hints worth the cost of a whole edition. No thrift is so wasteful as that of the man who foregoes a chance to gain the advantage of accurate knowledge. To guide him in that pursuit he refers to indexes. To be useful they must not only have passed through the sieve of a discriminating reviewer, but they must be correctly described. We confess that the labours of an indexer are rendered burdensome by the slovenly selection of titles on the part of authors. Articles entitled "Some Notes on . . . .", or "General Consideration concerning . . . .", or "Recent Observations upon . . . .", might as well be paraphrased as 'Random Remarks in regard to . . . .', 'Vague Generalizations about . . . .', or 'Belated Ruminations of . . . .' Titles should be definitive. 'Cyanidation in the Transvaal' is good because it would be indexed under 'cyanidation' and under 'Transvaal,' that is, a process and the region where that particular process is practised. 'Geology of Broken Hill' also is expressive, for it relates to one scientific subject in reference to a particular mining district. This is better than 'Notes on the geological structure of some Broken Hill mines,' just as the other is better than 'Recent progress in the cyanide process at the mines of the Transvaal.' A title should be brief, it should be as significant as brevity will permit, and it should give at least two salient points to which a reference may be attached. Unnecessary words should be ruthlessly deleted. Thus the article, both definite and indefinite, may well be omitted. 'The Geology of Broken Hill' includes an unnecessary word: the definite article 'the,' which is valueless to the indexer. Similarly 'A review of zinc metallurgy' contains one word too many: the indefinite article; for 'Review of Zinc Metallurgy' suffices. But these may seem minor points, for the competent indexer often entirely ignores the title of an article and uses his own judgment as to which word to use as an indicator of the subject discussed. The worst blunder is the saddling of a contribution or a book with a title that is misleading. 'Four weeks in Mexico' conveys nothing regarding the technical data that may have been gathered during that period; 'The experiences of a metallurgist in Canada' will barely stimulate even a lively imagination; 'Mining among the Malays' may relate to digging for gold tin, or rubies; it may refer to the placer operations, lode mining, or dredging; it may cover a barren effort or a profitable experience. Such titles are only aggravating, especially to the indexer, who, like the re-

viewer, asks to be spared from reading too much. Enough has been said; we desire only to add that it is a pleasure to index the earnest work of intelligent men and we regret no trouble that may be entailed in the preparation of a faithful record of the experience of mankind in the application of science to mining.

Buying Prospects.

Our friend the editor of the *Mining and Scientific Press* has had something useful to say regarding the buying and selling of 'prospects,' those baby mines that may possibly grow to the proportions of a big bonanza. It is notorious that the appraisal of prospects is difficult and the acquisition of good ones is rare, especially by operators having their headquarters at a great distance from mining regions. At a time like this when a new gold-mining district, such as Porcupine, is engaging attention it may be advisable to dwell on the subject. Obviously, if a London syndicate sends its mining engineer, usually a man well known by reputation, to look over the ground with a view to business, he is handicapped by having to deal with local people who know whom he represents and assume that being the representative of capital he will be willing to expend it lavishly. Moreover, the owners of claims are as familiar with local conditions as they are sanguine about the richness of their property. The visiting engineer lacks the time to investigate closely and to bargain deliberately. Hence no business is apt to result or prospects are optioned on preposterous terms. Another method is that by which owners of claims give an option to a speculator who then comes to London in the hope of inciting the interest of persons able to take the business off his hands at a profit to him. Twenty years ago such a visitor from the other side would get a $50,000 option on a mine and dispose of it in London for £50,000, returning as general manager, being thus enabled to follow a sanguine report with further hopeful statements for a period long enough to enable him to sell what shares he had been allotted at a handsome premium. Some of these silly things are still done but not all of them at the same time. Nowadays a deal is not consummated without some sort of inspection, the promoter's profits are less lavish, and the English company usually has sense enough to choose a manager not involved in the flotation. It remains obvious however that none of the procedure outlined is adapted to the acquisition of prospects, which, in the first place, do not justify a large expenditure of money in any form. And yet it is just such business as allows the handsomest margin to an enterprising financier or financial group. Another and better method may be suggested. The London people should form an alliance with a local syndicate, the latter making the search and acquiring the option, and then turning it over to their allies in London, on the basis of profits to be equitably apportioned. In some cases it may be advantageous for the London house to engage a local man as a resident agent or to send a tried employee to reside in the district so long as business seems likely. The man who does business in a hurry is at a disadvantage when dealing with another who can take his time. That is why prospects are rarely acquired on terms that permit expansion. And yet in earlier days some excellent deals were made by exploration companies, which preferred to buy half a dozen prospects involving small sums instead of purchasing the assured ore of one developed mine. If we may hazard a criticism of those who ought to know their own business better than any onlooker, we would say that the syndicates and companies devoted to the incubation of mining enterprises should strive to increase the efficiency of the sifting process involved in the search for mines by making alliances with local syndicates or by retaining engineers resident in such localities as present a chance for business.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

CORDOVA, ALASKA.

Coal and the coalfields continue to be the main topic of conversation in Southern Alaska. The decision in the Cunningham case, refusing patents to the claimants, is considered here to have been essentially a political ruling. Public opinion was so aroused by stories of attempts to bottle up Alaska in the interests of the Guggenheims that the Department of the Interior was constrained to refuse patents for fear of popular wrath. At least that is the common local opinion. If it be correct, it must be said that the Cunningham claimants made out a disappointingly poor case as a matter of law, and the Government had better ground for cancelling the claims than had been anticipated. Under former conditions the land probably would have been patented without objection, but in Land Office procedure many things are passed if unquestioned that become highly important once objection is made. The more significant fact connected with the decision is that the Commissioner adopted what amounts to a new interpretation of the law. The statutes require that in order to acquire public coal-land the entry-man must have opened a 'mine.' In practice, it has been customary merely to face up the coal to determine its thickness and extent, the character of the roof and bottom, and other things essential to planning workings. Prospecting drifts have been driven but no real attempt to mine has been made prior to receiving patent to the ground. This is the natural and business-like way to proceed; especially in a far-off country such as Alaska where transportation must be provided, and markets are none too certain. The Cunningham claimants proceeded in accordance with this custom but the point being raised, the Commissioner decided that the fact of no 'mine' having been opened constituted a fatal defect in title and refused the patents. This amounts to a ruling that there is no law in existence under which coal-land can be taken up in areas and under conditions demanded by modern industry. It is a radical step, but probably represents the real facts. It puts up squarely to Congress the duty of enacting a reasonable and modern law. In the meantime Congress is playing politics and Alaska is neglected.

CORDOVA, ALASKA.

Mining and Politics.—It is announced that Walter L. Fisher, Secretary of the Interior, accompanied by Alfred H. Brooks, chief of the Alaskan branch of the United States Geological Survey, W. E. Clark, the Governor of Alaska, and other officials, will

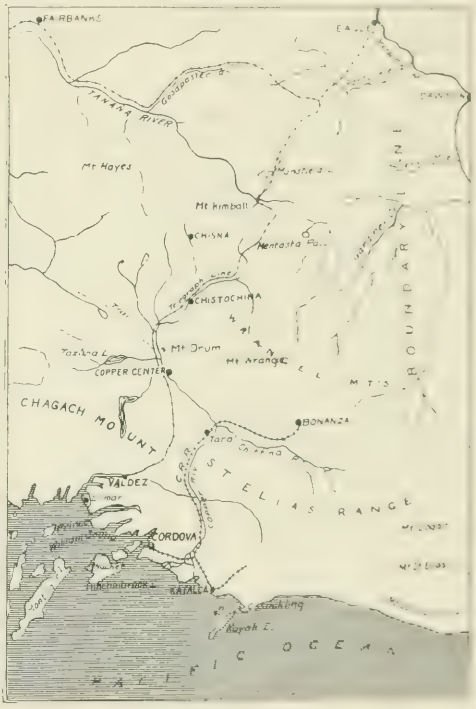
visit Katalla, Cordova, and other points in this part of the territory in August. Much good is expected from this visit since Mr. Fisher has an enviable reputation for ability and fairness. Alaska has had little to blame in those Government officials and others who have been on the ground. The troubles have arisen from misrepresentations disseminated by non-residents. While the coal-land situation is now in such a muddle that Congressional action will be necessary to straighten it out, much can be done by an intelligent and friendly Secretary of the Interior. At present things are at a standstill. The Cordova & North Western railway has been completed to the Kennicott copper mine, but no line has been built to the coalfields. It is understood that surveys and materials are ready for instant building from Katalla Junction whenever the Government permits a mine to be opened. The Morrow interests are applying for patent under the law of 1908 and there is much interest in the question whether or not their claims will be allowed. As that law only permits entry of a restricted area, 2580 acres, and includes a strong anti-monopoly clause, there is not the same popular objection in the States to giving patents under it as under the earlier laws. Mr. Fisher has also suggested that the Navy open a mine of its own in the coal-reserve. This would relieve the situation in part, especially if, as a temporary measure, surplus coal should be sold to local dealers. It will be remembered that in the Philippines the Army opened a coal mine and later withdrew from the general market when private firms were prepared to supply. At present coal costs large buyers $9 per ton on the dock in Southern Alaska. Retail prices, naturally, are much higher. In a country of long cold winters where wood is poor and none too abundant, this imposes a real hardship on the settlers, especially when it is remembered that excellent coal is available within a few miles of tide-water. Passage of the reciprocity agreement with Canada should reduce the price a little, but not much. The C. & N.W. Railway, the Beatson Copper Co., and other enterprises of the Alaska Syndicate are planning to give up burning coal and use Californian oil. This can be delivered at a cost of $1 per barrel or less and tanks can be erected at about the same price. In view of the higher efficiency of oil and the great economy in handling it, there would seem to be no market among larger users for the Alaska coal even when mined. Indeed, engineers figure that Californian oil can be burned to advantage in the locomotives that will haul the coal to tidewater. This, however, does not meet the problem of the small user, of the tramp steamer, or of the Navy, which for strategical reasons seems to prefer to cling to coal as fuel.

Petroleum has been found in Alaska, but the immediate prospect of developing sufficient local supply is not brilliant. At Katalla about six years ago an English company put down fifty or sixty holes, found considerable gas, and 'brought in' five or six wells. These were 'capped' and as, under American law, an alien corporation cannot receive patent to mineral land, the property was sold to a domestic corporation. There were financial complications and a receiver was put in charge. He leased the property to a man who erected a diminutive refinery and laid a 2-inch pipe-line to the wells. The oil proved of exceptionally high grade and gasoline was made for a flourishing local trade. Absence of suitable harbour, the small scale of the enterprise, and various other complications, prevented the growth of the industry.

The patent area was small and the surrounding lands were withdrawn from entry. This spring the receiver was discharged; it was announced that contracts had been made with the Standard Oil, and that the field was to be opened. The wells were uncapped and pumping was begun. It promptly became apparent that the production so far developed was too small and the company did not have money for further drilling. The pay-roll was not met and the whole enterprise was closed down again. Probably no further effort will be made to open the field until after Congress shall have determined on a policy with regard to the withdrawn lands, but there is considerable reason for thinking that a valuable oilfield will ultimately be developed.

Gold prospects.—In the meantime attention is being centred upon prospecting for gold-quartz veins. These have long been known to exist in the mountains that fringe the coast but no one has ascertained how valuable they are. Alaska is a hard country to prospect. The season is short and the surface is apt to be covered either with snow or a damp layer of moss and scrubby brush. This with the absence of trails, high cost of supplies, and few opportunities for prospectors to replenish their supplies by working a few weeks for wages, has hindered exploration. In 1910 there was an unusually long summer season. The snow melted early and the mountain slopes lay bare. Railroad construction brought many men into the country and prospecting

flourished. One of the districts brought to the front at that time was McKinlay Lake. This is situated about 23 miles from Cordova and about three miles from the C. & N.W. railway. It is accessible both by railway and launch. Gold-quartz veins have been known there for a number of years. The Lucky Strike group of claims was acquired by a small local syndicate headed by a man named Rice, a locomotive engineer. They had fair success in developing their property and found a deposit, variously reported to be diorite or greywacke, and probably the latter, some 40 ft. thick and full of stringers of quartz carrying free gold. An option has been taken on it by Stephen Birch, of the Alaska Syndicate, and J. F. B. Erdlets has been making an examination. The option calls for $158,000 in payments extending over 18 months. It will cost a good deal to sample and determine the value of the property, but if the ore comes up to expectation, $10 per ton, it should be cheaply developed and worked. Another property that has been recently optioned is that of the McKinlay Lake Mining Co. This is under examination by C. H. Pearce, for Bratnober & Lukach. It is said that men affiliated with the London Exploration Co. are concerned in the venture. With these exceptions the claims are in the hands of local prospectors and merchants, who, it must be said, have spent money liberally, if not always advisedly, in attempting to determine their value. It was expected that this season would see a great deal of prospecting. Completion of the railroad throws out of work a large number of men who had money for outfit and grub. The snows, however, held on late, and in the end most of them became discouraged and went to the States. At Valdez things are more active. The continued success of the Cliff Mining Co., which has produced $400,000 and paid $60,000 in dividends on an initial investment of $25,000, all within 18 months, has encouraged everyone to work on his claim. Naturally the veins exposed along the shore and therefore most accessible are receiving most attention, but along the glacier and up Mineral creek many properties have not only been staked, but are being really prospected. So far the discoveries are of quartz veins carrying free gold. Although narrow the veins are rich. The Cliff mine has now an average of 11 inches of ore in the stopes but the mill-feed is running about $87 per ton. Three Nissen stamps, amalgamating plates, and two Wilfley tables constitute the plant. The plates must be cleaned every day and require constant care. The capacity is 19 tons per day. The vein has been developed to a depth of 250 ft. and stopes opened also on a parallel vein 44 ft. east. Up Mineral creek about six miles is another centre of activity. Here B. F. Millard, who made a success of the Cliff, has just paid $100,000 for a three-quarter interest in the property of the Mineral Creek Mining Co. With him are associated George B. Harris and other wealthy Chicago men, but in general the money used at Valdez has been raised locally. The community has



Part of Alaska.

shown a commendable disposition to back its own game and is thus exhibiting the same spirit that made the larger Western mines.

Copper.—After all is said and done copper is as yet the big resource of this region. Three mines are shipping largely and regularly. The Beatson Copper Co., on La Touche island, is sending ore steadily to the Tacoma smelter and is planning a concentration mill for handling the low-grade material. An option has been taken on the adjacent Barrack Girdwood property and a drill will be set to work in an effort to find orebodies. W. H. Seagrave, formerly at Ely, Nevada, is now in charge and has made many improvements. The Ellemar mine is shipping the

last of the high-grade ore that formed the centre lens of its orebody. This was made accessible by a coffer-dam built around the part of the vein that is covered at high-tide. This particular lens of ore, 10 to 15 ft. thick, and containing roughly 10 to 12% copper, has been worked out at a depth of 600 ft. Whether another lens will be found is uncertain, though, in the opinion of engineers who are familiar with the property there are excellent chances. The Fidalgo, Three Man, and other properties along the coast are continuing developments with excellent results. The Bonanza mine at Kennicott is so far making good all the claims of its most enthusiastic admirers. A mine that ships by the train-load ore containing 71% copper and 19 oz. silver is certainly a wonder. The mine produced 6,000,000 lb. copper within three months of the advent of the railway. The orebody is essentially a replacement of limestone by chalcocite. The bed thus enriched is roughly 40 ft. thick and, as a result of faulting along an anticline, dips into the mountain. It has been developed continuously 250 ft. below the outcrop and shows the same rich ore. At present the low-grade material is not being shipped but a mill is being built and should be ready for operation in October. E. D. Emery, who will be remembered for his work in Mexico, is in charge. That there are other big properties still to be opened seems certain. H. A. Keller has been examining the Mother Lode mine, the supposed continuation of the Bonanza, for New York men, and Stephen Birch has been looking at the properties of the Great Northern Development Co., near mile 146. M. D. Draper is in charge for the Hubbard-Elliott interests a little farther west, and there have been an unusual number of experts in the country this year; all of which bodes well for the future.

TORONTO.

Porcupine. — The earlier reports of the fire which devastated Porcupine in July were greatly exaggerated. The total number of deaths so far ascertained is seventy-three, and the loss of property is estimated at $1,250,000. The fire covered an area of about 10 miles square in the Porcupine district, and had no connection with the less destructive calamity, which some days earlier destroyed the town of Cochrane about 30 miles to the north. The work of reconstruction is proceeding as rapidly as possible, though considerably delayed by the difficulty of procuring timber and other building materials. Large shipments have been going forward by the Temiskaming & Northern Ontario Railway, and for some time there was much difficulty in making deliveries on account of the congestion of freight on the sidings. Latterly, however, this has been overcome and things have been running more smoothly. The burned towns are being rebuilt in a more substantial manner, and buildings of a better class will replace the flimsy and inflammable structures swept away by the fire. In Porcupine City twenty small buildings have been erected since the fire. In South Porcupine some business houses are preparing to erect first class buildings of brick and cement, and as soon as material can be had in sufficient quantities, an active building boom will commence. At the mining camps also the new buildings will be of a more substantial type than those destroyed.

At the Hollinger, reconstruction is proceeding steadily. The work is not delayed by the difficulty of obtaining timber, as the company cuts its own supplies at the mill on Miller Lake. Foundations for the compressor and the boilers are almost completed and the site for the mill is being cleared. The Dome has a large force of men at work building a spur line to connect the mine with the railway. The fire burned the overburden on the south and east portions of the property, exposing bodies of quartz and schist, which are considered likely to add to their available orebodies. Prospecting will be undertaken by test pits. At the West Dome, steel and concrete fire-proof buildings will be erected. John B. Cleveland, formerly of Arizona, has been appointed manager in place of Robert A. Weiss who lost his life in the fire. The Vipond has ordered a new plant comprising an 8-drill compressor, boilers, and a hoist. The main working shaft is to be put down to 200 ft., and cross-cuts run at this level to tap No. 2 and No. 3 veins. The latter is 18 ft. wide at the 100 ft. level, and carries high-grade ore. The Pearl Lake has ordered a 12-drill compressor with a 200 hp. motor to run the plant with power from the Mattagami river. A new vein discovered on the Dome since the fire, 18 in. wide with a good surface showing of gold, has been followed into the Dome Extension property adjoining. An important strike has been made on the Jupiter, now under option to the Drummonds, the vein which was encountered in cross-cutting being 4 ft. wide and rich in native gold. The McIntyre will put in a stamp-mill and cyanide plant. Shafts are down on the north and south veins nearly 200 ft. and cross-cuts are

being driven between them. The Rea mine is looking well at the 200 ft. level. The ore-body has been followed by drift for 100 ft. In the face of the vein 4 ft. wide, native gold runs across the entire width. On the Crown Reserve Porcupine property some rich ore has been found at the 50 ft. level, the vein being 3 to 5 ft. in width. A vein has also been discovered coming out of the Hollinger property, which may be the main Hollinger vein. The American Goldfields have decided to begin sinking on their property immediately. The Pike Lake in the Swastika area has a wide exposure of quartz and ankerite showing much native gold. Core drilling will be undertaken and several holes put down 300 ft. A. H. Brown, who installed the Coniagas mill is in charge. At the Lucky Cross, another Swastika property, two promising but narrow veins showing gold have been found.

A party representing the Bewick-Moreing interests, including C. A. Moreing, Sir Wm. Bell, Graham Prentice, W. J. Loring, and G. Lovell, visited Porcupine about the end of July. It is understood that the company has undertaken the exploitation of 52 claims comprising 2080 acres in Murphy and Wark townships, belonging to a syndicate represented by L. S. Colwell, G. T. Hartt, and R. Howard. More recent visitors were Louis Reyersbach and H. F. Marriott of London, representing the Wernher-Beit-Eckstein interests.

A number of important deals in Porcupine claims have lately been made. Baron G. von Polenz, of Berlin, acting for British capitalists, has purchased the Christ claims in Tisdale township for $235,000. The Routley claim, near Pearl Lake, has been bought by Daniel F. Yost, C. A. Burdick, and other New Yorkers. The five Davidson claims in Northern Tisdale have been sold on option to interests identified with the Crown Chartered Co. A thorough test is to be made, and a shaft sunk to 200 ft., and if satisfactory results are obtained the sale will be completed at a price stated to be $175,000. John C. Hicks, of New York, has purchased the North Thompson property for a price said to be about $250,000. The McAulay-Brydge property in Bristol township has been sold to B. E. Cartwright for $500,000. A. D. Miles, consulting engineer for the Dome Mines, has taken an option on the Jowsey-Wood claims, seven in number, in the Cripple Creek district, for $250,000.

BEGINNINGS OF THE HOLLINGER MINE.

Cobalt.—The value of the output of Cobalt can no longer be estimated by the tonnage of ore-shipments owing to the increase in the proportion of concentrates, and in the amount shipped in the form of bullion. The tonnage for the first half of the year shows a considerable falling off as compared with the first six months of 1910, the figures being respectively 11,978 and 14,868 tons, a decrease of 2890 tons. The value of the ore and bullion shipments on the other hand shows a satisfactory increase, being $7,972,333 for the first six months of the present year, as com-

pared with $6,103,372 for the corresponding period of 1910. Nipissing has latterly shown considerable weakness on the stock market, owing possibly to the fact that the profits for the half-year, amounting to $858,891, fell below the dividend requirements of $900,000. This is easily accounted for by the shortage of power early in the season which curtailed the output. Prospecting has also been retarded pending the installation of the hydraulic plant with which it is proposed to remove entirely the overburden so as to uncover every surface vein. The plant will comprise a turbine pump with a capacity of 4800 gallons per minute and a 700 hp. motor. A large area of the property remains altogether unprospected. The work is expected to begin this fall. A statement as to the company's condition as on July 1 shows cash in bank $803,205; ore in transit and at smelters $264,118; ore sacked for shipment, $251,957; total $1,419,230. The La Rose has made an important strike on the Princess property where ore running 4000 oz. to the ton has been struck in a winze sunk from the 235 ft. level. The vein is about 8 in. wide. The Violet mine owned by this company is being again worked after being closed for some years. A statement of the condition of the company on July 1 shows cash in bank, and value of ore in transit and at smelter $1,184,242; ore sacked for shipment $162,311, total $1,346,553. The Coniagas declared a dividend of 6% and bonus of 3% payable August 1, making in all 27% declared so far this year. The Crown Reserve's report for the half-year showed a production of 1,582,994 oz. silver of a net value of $795,829, and a profit of $654,287. Dividends were paid to the amount of $530,644, being 30% for the half-year. The Rochester has let a contract to the Lumsden Mining Co. to explore the Rochester location from the 250 ft. level of the Lumsden where a 4 in. vein of smaltite has been struck. The Ophir is in good ore in two veins at the 300 ft. level. The Trethewey mill has been overhauled and automatic samplers and weighing machine installed. With the mill treating 2500 tons per month there is ore in sight for a two years supply. Prof. W. G. Miller, of the Provincial Mining Department, and Cyril W. Knight are making a further study of the Cobalt field in view of recent developments, more particularly as to the possibilities of ore continuing in the diabase formation. In the case of the Temiskaming mine the ore in the lower levels pinched out as soon as the Keewatin gave place to the diabase.

Lake of the Woods.—There has of late been a marked revival of interest in the Lake of the Woods gold mining district, and several formerly productive mines, which have been closed for long periods are again working. At the Mikado, where operations were resumed a year since, large new orebodies were discovered, and 15,000 tons blocked out. The ore, however, proved refractory owing to its bismuth content, and a cyanide plant is to be installed, operations in the meantime being on a limited scale. The Ophir mine is being successfully worked after being idle for 20 years. The shaft has been sunk to 100 ft., and the vein carrying good gold contents has widened at depth to 9 ft. Drifts are being run at 50 and 100 ft. The Black Eagle, also known as the Regina, which has been idle for three years and has extensive workings and a good equipment, is to be unwatered and examined with a view to its purchase by an English syndicate.

Porcupine.—The market for Porcupine shares has latterly been dull with prices steadily dropping. In addition to the causes usually assigned for depression, including the tightness of the money market and midsummer stagnation, there is a more serious reason for the slump. Investors have been rendered timid by the unfavourable report on the district issued recently by the Ontario Bureau of Mines. The writer, A. G. Burrows, points out that the Keewatin and Huronian formations, which contain the gold-bearing veins, have been subjected to much greater metamorphism than at Cobalt. The occurrence of gold is associated with the quartz solutions that circulated through the fissures. Irregular fissuring has produced much variation in the orebodies, some being tabular masses of quartz or lenses traceable for several hundred feet; others mere veinlets often only a fraction of an inch wide and a few feet long. The latter variety is well illustrated by the fissuring of ankerite bands characteristic of many of the gold deposits. Irregular and lenticular quartz bodies having a width of 10 or 20 ft. may die away in a distance of 50 ft. Again, there are dome-like masses of quartz which are elliptical or oval in surface outline, but whose underground extension has not been examined closely. In some parts at least, these masses can be seen in contact with underlying rocks at a low angle, which would suggest that they are broad lenticular masses that have filled lateral fissues in the country rock. "The distribution of the gold," the report goes on to say, "is generally irregular,

occurring along one or both walls, while other portions of the vein may be very low-grade. Most spectacular showings occur on many properties, but these are limited to portions of the veins. Considering the irregular character of certain veins and the quantity of country rock which will need to be mined, the ore must be considered low-grade."

JOHANNESBURG.

Changes in the Groups.—The perpetual shuffling of the personnel of the various mining groups still continues, the latest changes being those that have just taken place under the Barnato group. W. M. Prout, an old

A DECANTATION PLANT ON THE RAND.

servant of Barnato Bros., leaves the Witwatersrand Gold Mining Co., his place being taken by A. White, who was assistant consulting engineer to J. G. Lawn. R. Clarkson also leaves the New Primrose, his place being taken by H. Van Eyssen, late of the East Rand Proprietary. The Rand Mines has made a small change, in that it now appears to have dispensed with a sand-filling expert. Edgar Pam, who held that position, has been appointed a sectional manager on the Geldenhuis Deep, M. O. Tillard having left that mine and taken a position as sectional manager on the Nourse Mines.

Native Labour.—This is the most important question facing the local mining industry. There is a serious shortage of native labour. Africa, from a recruiting point of view, is divided into two parts by latitude 22°. The first part comprises the recruiting districts north of that line, namely, Beira, Chinde, British Nyasaland Protectorate, German South West Africa, Mozambique, North Eastern Rhodesia, Fort Jameson, Nyasa, Southern Rhodesia, Zambesia, Quilimane, and Tete. It is from these areas only that an increase in the native labour supply can be hoped for. Against this we have the high death-rate among the boys that come from these districts, the average rate being about 80 per 1000 per annum. The district south of lat. 22° comprises Basutoland, British Bechuanaland, The Cape, Natal, Zululand, Orange Free State, Swaziland, and the Transvaal. These are practically drained, in so far as any increase of supply is concerned. The average death-rate of natives from these areas is about 30 per 1000 per annum.

The average number of natives employed in all mines and works in the proclaimed labour districts of the Transvaal is about 218,000. Of this number about 193,000 are recruited from the districts south of lat. 22° and the remaining 25,000 from the northern districts. Owing to the high mortality among the latter, the Government will probably stop further recruiting unless the mines can show healthier conditions. To this end rules have already been framed making it compulsory for all these natives to use a proper change-house and baths, and to go from the change-house to the shafts in covered ways, etc. The question remains whether all this extra trouble

will decrease the mortality. It seems unlikely. In the first place it is of little use trying to take care of natives when they do not understand how to look after themselves. Generally speaking, the mortality of all natives due to disease is about 30, and half of this, that is 15 per 1000 per annum is due to pneumonia, while phthisis accounts for another 5. The death-rate from accidents is about 3 per 1000, so that the total death-rate from all causes is 33 per 1000. With regard to the natives from the north of lat. 22°, while they are suited for work in the hot rarefied atmospheric conditions of the Tropics, they cannot be acclimatized to the conditions of the Rand. This is an important point and must not be overlooked. No matter with what care the Tropical native is treated on the Rand, only the fittest will survive the severe climatic conditions with their great variations in temperature.

Government Training School. — The Government school for the training of miners was officially opened last month at the Wolhuter gold mine, Johannesburg, where provision is made for 50 apprentices under the following conditions:

(*1*) Youths selected to undergo a general course of underground training; they must be of first-class physique and pass a rigorous medical examination.

(*2*) No person under 17 years of age or over 25 years of age shall be allowed to undertake such course.

(*3*) An agreement with the committee binding him to work for a period of three years underground, in consideration of a progressive wage, shall be entered into on behalf of the apprentice.

(*4*) The three years course shall comprise, amongst other matters, the following underground work: (*a*) Timber Work; (*b*) Pipe and Plate-Laying; (*c*) Pumps; (*d*) Hand-Drilling; (*e*) Machine-Drilling; (*f*) Ambulance; (*g*) General Mine-Work.

The time to be occupied on each of the above branches of work and the order in which each branch, with the exception of machine-drilling, is to be taken, shall rest with the discretion of the instructor. The application form and draft indenture are published for general information, and all applications are to be addressed to the Chief Inspector of Mines, Johannesburg. The following certificates are to be attached to the application form: (*1*) a medical certificate, especially in respect of the condition of the applicant's lungs; (*2*) a certificate of character, from a magistrate, justice of the peace, clergyman, or other responsible person.

This excellent scheme has therefore at last been put into execution by the Government in conjunction with the direction and management of the Wolhuter gold mine. A portion of this mine has been handed over and will be run entirely by the students under the personal supervision of one of the foremen. The success or otherwise of the scheme will depend upon the students, of whom there are at present about 30, and in turn their keenness for the work will depend on the capacity and enthusiasm of their instructors. The students will receive pay ranging from 4s. 3d. per day, at the commencement of the course, up to 6s. 9d. for the last three months of service; out of this he will pay £3. 5s. per month for board and lodgings, 7s. for medical attendance and benefit society, and 1s. for the reading-room, making in all £3. 13s. per month, which leaves a margin of £1. 13s. 3d. for pocket money, on a basis of 25 working days per month at the minimum rate of 4s. 3d. per day. It will be interesting to see what class of students will avail themselves of this opportunity of obtaining a cheap and excellent training. I am inclined to think that 25 as a maximum limit for the age of the entering student is too high, and that it would have been better to have made it 21 years.

Brakpan and Van Ryn Deep.—These two mines are situated next to each other in the Far East Rand. The Van Ryn Deep is on the first row of deep-levels, and the Brakpan is a second 'deep' below it. Brakpan recently started milling, and its ore reserve on May 31 was as follows: Payable 2,035,108 tons, averaging 6·62 dwt., about 69% of the total tonnage developed; unpayable 876,671 tons, averaging 2·16 dwt., about 31% of the total tonnage developed. These tonnages are calculated over an average stoping width of 52½ inches. From these figures it would appear, assuming the removal of 10% by sorting, and allowing for an assay-factor of 90% and an extraction of 95%, that the probable return per ton of ore milled will be about 24s. With a new mine just starting the probable cost per ton milled should be about 20s., leaving a margin of 4s. per ton as profit.

The Van Ryn Deep for the first time gives an estimate of the ore reserve in the quarterly report. The figures are as follows: 365,165 milling tons of payable ore averaging 6·6 dwt. and 119,800 tons of unpayable ore, averaging 2·72 dwt. From this it would appear that the Van Ryn Deep and Brakpan mines, so

far as development has gone, are in an area having a fairly consistent value of about 6·6 dwt. throughout. At the Van Ryn Deep the lode has been located, by means of a borehole, south of the big fault, which has a downthrow of about 400 feet.

The first returns for a complete month have been published by the Brakpan. The yield per ton milled during July was much higher than the average anticipated, being 31s. 9d. as compared with 24s., and the profit was 9s. 11d. Apparently efforts have been made to give the mine a cheerful start by picking some good ore. But there is probably another explanation of the high figures, namely, that the gold recovered during the days in June when the mill commenced crushing has been included in the returns, though the tonnage of ore treated was not. It will be interesting to watch the future fall in grade and also a possible reduction in cost. The extraction during June was reported at only 19s. 11d. per ton, a low figure due to absorption of gold by the amalgamating plates and the cyanide plant. The plates usually receive unnecessary blame. In reality it can be taken that a plate 12 by 5 ft. will not require more than 20 oz. left on it after the first month's working. At Brakpan there are 30 plates, so the absorption would be about 600 oz., worth £2520. At least half this amount could be removed at the end of the second month, if required.

Education of Mining Engineers.—The discussion on the education of engineers that took place recently at the Institution of Civil Engineers in London has attracted attention on the Rand. Judging by my own experience here I am inclined to think it best for a youth, after passing a preliminary university examination such as matriculation, to go straight to a two years' apprenticeship with a home firm of engineers and have the run of a mine or colliery. Thus he would learn the mechanical and practical details, and his suitability for this branch of occupation would be tested before embarking on a long period of expensive education. A youth thus made familiar with the problems to be solved would appreciate the lecture courses in quite a different way from one straight from school. At the present time all that is done in London for the practical instruction of students, as far as the Rand is concerned, is the appointment of eight of the most successful answerers of examination papers to a year's post-graduate course out here. It is a sufficiently well-known fact that success at college does not necessarily mean success in the handling of the serious problems of mines. We want more young men that have stood the test of practical work before coming here. There is a scarcity of English educated engineers on the Rand and the indications are that the young Dutchman who grows up in the mining districts and understands from his earliest years what will be his responsibilities will gradually beat his English rivals. This change is not very apparent as yet, but it will nevertheless come in time, and a ministry with Dutch sympathies would naturally favour any proposition to help forward the aspirations of the Dutch race. Something more is therefore required at home in order that the young English mining engineer shall be practically and scientifically educated if he is to hold his own in South Africa.

SAN FRANCISCO.

Goldfield, in Nevada, has been in danger of becoming known as a one-mine district. The magnificent output and excellent technical work that has characterized the record of the Goldfield Consolidated Mines Co. has so monopolized attention that other properties in the district have received little attention. This tendency has been all the stronger since the collapse of the wild orgy of speculation that characterized the discovery of the district. It has been recently estimated that when the bubble burst there were over 300 Nevada companies organized on the one million share basis and engaged in distributing stock to an eager public. Most of them had no substantial assets, a large number being founded on a mere option to purchase unprospected ground. In many cases the shares of such companies sold on a basis that involved payment of $1,000,000 for small areas of wholly unproved value. So long as money was plentiful and speculation rife, the good shares carried the bad and money was promptly forthcoming. Such a condition could not last and in the end resulted in large tracts resting in the hands of impecunious companies unable to go ahead with development and unwilling to sell at any reasonable figure. At Goldfield there is a large area of ground that will warrant reasonable expenditures for prospecting but the work must be carefully done and there is no assurance of fabulous returns in any particular case. Attempts are now to be made by at least two responsible concerns to develop deeper ground where shallow work has shown promise. The Goldfield Deep Mines Co. has been formed to sink on ground belonging to the Goldfield Merger Mines Co.

Essentially this is an attempt to test in depth veins known to be rich in the Goldfield Consolidated mine and which dip out of the territory belonging to that company. A shaft 2000 ft. deep is planned. Backing the new enterprise, among others, are George Wingfield of the Consolidated and W. A. Clark, whose interest was enlisted through the necessity of providing freight for the Las Vegas & Tonopah railroad, of which he is the main owner. Another attempt to develop a deep mine is that of the Goldfield Belmont company, which is practically owned by men in the Tonopah Belmont company. This, in turn, is closely affiliated with the Tonopah & Goldfield railroad, which, like its competitor, has learned that a district that ships only gold in bricks, even if shipments are occasionally in ton lots, furnishes but little freight. The Tonopah Belmont people have made a conspicuous and deserved success at Tonopah, as has Mr. Clark in Montana and Arizona, and the serious entrance of such men into the Goldfield district means much. As an example of the contrast between present and past performance there it is worth mentioning that both the Goldfield Merger and the Goldfield Belmont properties were first carefully surveyed by a competent geologist, George H. Garrey, of Spurr & Co., and plans for development were formulated after that study. These and the Consolidated are not the only properties at Goldfield, but they are the ones most in the public eye. The Florence continues regular production, ranking next to the Consolidated, and a number of smaller mines are shipping.

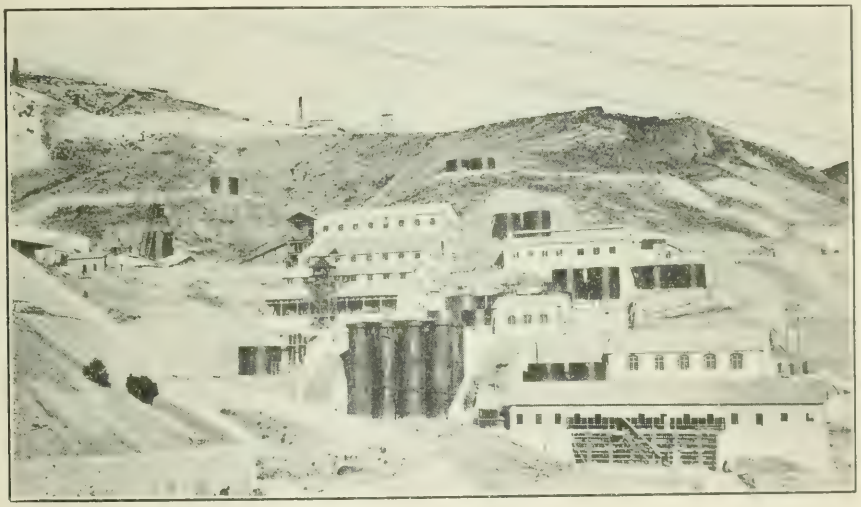
Manhattan is another of the Nevada districts whose early history was marked by a blighting boom, but which now bids fair to 'come back' in a substantial manner. The War Eagle company is operating the mill built for the Manhattan Ore Reduction & Refining Co., on the basis of experimental work done by F. L. Bosqui and J. H. G. Wolf. While the mill is small, consisting of 10 stamps, it operates on custom ore and permits lessees to obtain cash returns. One company is now paying dividends, others are being re-organized, litigation is being settled, and placer mining has been undertaken. Altogether matters are distinctly more hopeful at Manhattan than at any time in two or three years. At Wonder, Nevada, the Nevada Wonder M. Co. has just begun crushing, and nearby the Nevada Hills is expected to begin in a few days. At National a remarkable output of extremely rich ore continues to attract attention. Dividends have been resumed on the Comstock and there are many signs of a more prosperous period for Nevada miners. Incidentally that State has now one of the strictest laws regarding organization and promotion of mining companies of any American State, and has also recently revised its law regarding mine inspection. The new statute follows closely the draft prepared by the Mining and Metallurgical Society of America and the only criticism that has yet been made is that it is, if anything, too full and strict. That, however, is better than the old system of no law.

California as well as Nevada is feeling the influence of a returning interest in gold mines. Along the Mother Lode serious studies of the possibility of cyanidation are being made. The standard Mother Lode practice of stamping, amalgamation, and concentration on vanners, followed by treatment in canvas plants, has been followed so long that belief in its perfection has become ingrained. Repeated trials of new processes and new devices have been disappointing and mill-men along the Lode have settled down to doing the best they can with the processes in use. It is generally believed that the tailing losses are but 25 to 30c. per ton and that most of this loss is in the form of gold locked in fine particles of pyrite. The sampling of tailing is always difficult and leads to many discordant results but enough is now known to make certain that tailing losses in this district are several times greater than have been estimated. This, with the improvement made elsewhere in cyanidation of concentrate, opens distinct possibilities of increased return and working-scale tests may be expected.

Attempts made by San Franciscans to buy the Zeila mine at Jackson have come to naught but a new company has been organized, the South Jackson G. M. Co., to mine on adjacent ground. Immediately south of the Zeila is a tract that has long lain idle, presumably because it was held under agricultural title. In early days excellent ore was mined to a depth of 80 ft. on what is considered to be the 'West vein' of the Mother Lode. A shaft is now being sunk on the dip to intersect this vein and prospecting is also being done along the 'East vein,' which likewise crosses the property. The famous old Princeton mine is also to be reopened. This mine, which lies within the Mariposa grant, has produced over $5,000,000 and has been worked to a depth of several hundred feet. The bottom level was in low-

grade ore and some time since was abandoned. The vein, however, is large and well defined and since horizontal bands of low-grade or barren rock are known to occur in even the best of the Mother Lode mines the property is considered worthy of further test. As Hennen Jennings and W. W. Mein are active in the new enterprise it goes without saying that the work will be well directed and well conducted.

Shasta county mines are in a bad way since the closing of the copper smelters there. The Mammoth plant of the United States Smelting Co. is the only one now in operation. It is a striking commentary on the situation that the air is full of rumours of a joint removal on the part of the companies concerned to western Nevada, and that in the meantime the Pacific S. & M. Co. has contracted for the delivery of a considerable tonnage of copper ore to its furnaces at Guaymas, in Mexico. There is general disappointment among technical men at the failure, in part, of the Cottrell process at the Balaklala smelter. Tests made by experts for the farmers credit it with an average performance of 72%, though individual units had been brought up to a duty of 90% in precipitation of solid particles. The simplicity and low cost of the plant are strongly in its favour and among those who have watched the development of the process there is a general belief that ultimately it will be entirely successful. Since the closing of the Balaklala plants the experimental work has been transferred to Garfield, Utah, where while there is no trouble from smoke damage the management desires to use the apparatus to minimize dust losses. The process is also being applied to precipitation of dust at cement plants. The Riverside Portland Cement Co., after several months experimental work, is now equipping its plant at Coulton. The significant feature of this work is that the precipitation must be conducted at much higher temperatures than in clearing petroleum of water, settling acid fume, or handling smelter-dust. Mr. Cottrell is now in general charge of western metallurgical investigations for the United States Bureau of Mines and just at present is making a careful study of the Washoe smelter at Anaconda, Montana.



LA BLANCA MILL, AT PACHUCA.

MEXICO.

Tiro General.—A recent transfer of importance was that of the Tiro General mines in the Charcos district of San Luis Potosi, purchased by the American Smelting & Refining Co. at a price of 1,600,000 pesos. The purchase included the Potosi Central railway, 10 kilometres long, extending from the mines to Charcos station, on the National Railways of Mexico. The mines have been owned by the Tiro General Mining Co., composed principally of foreigners living at Aguascalientes and Mexico City. For a number of years they have been shipping steadily to the Aguascalientes smelter of the American Smelting & Refining Co. Shipments have ranged from 1500 to 4500 tons of ore monthly. The mines are *antiguas*, extensively developed,

with a record of having produced ore worth many millions during the last century. The valuable constituents of the ore are sulphides of silver and copper, with lead, zinc, and iron. A few years ago the Tiro General Co. tried dry concentration, but the treatment was not a success and the plant was closed.

Oil.—The Texas Oil Co. has purchased 80 acres of land on the Panuco river, at Tampico, preparatory to erecting storage-tanks there, purchasing Mexican crude oil, and exporting to the United States. It was reported that arrangements had been made to handle the surplus crude oil of the Pearson interests, but a few days ago a Pearson representative in Mexico City stated that the Sherman law of the United States might interfere with the plan. This point is not clear. The *Nueva Era*, recognized as the organ of Francisco I. Madero, recently printed a telegram from New York stating that Lord Cowdray had been unsuccessful in attempts to dispose of his Mexican oil holdings, because foreign capitalists feared an attack by the Mexican Government on the Pearson concessions. The East Coast Oil Co., a Southern Pacific concern, has brought in a gusher of from 10,000 to 15,000 barrels daily in the Topila field. Owing to the ability of the Doheny interests to furnish large supplies of oil from their Juan Casiano wells, the National Railways of Mexico are increasing the use of oil as locomotive fuel. The Mexican Petroleum Co. of California, a Doheny company, is supplying oil to the government merger system under a contract made with the Mexican Central Railway.

Mexican Light & Power.—The annual report of this Canadian company owning the big hydro-electric installation at Necaxa, State of Puebla, and furnishing current to Mexico City and the mining districts of El Oro and Pachuca, shows gross earnings of 6,990,398 pesos, and net earnings of 5,021,625 pesos. The operating and maintenance expenses were only 1,968,773 pesos, as against 2,991,207 pesos in the previous year. The company reports a total generating capacity of 129,920 horse-power, this total including the plants taken over in Mexico City and Pachuca in addition to the 94,000 horse-power possible at Necaxa. Contracts have been let for the further extension of the system of canals and tunnels at Necaxa, which will result in diverting other rivers into the Necaxa watershed, and by the end of 1912 the generating capacity at Necaxa will be much greater.

Lucky Tiger.—A. S. Witherbee, J. J. Stein and A. S. Everest, London brokers, have been negotiating for an option to buy 645,000 shares of the stock of the Lucky Tiger Combination Gold Mining Co., owning the Lucky Tiger gold mine, in Sonora. They recently arrived at Kansas City, where the majority of the stock is held, and made a deposit of £98,000 in connection with the desired option. They are asking for 6 months on 370,000 shares at $7 per share, and 9 months on 275,000 shares at $8 per share. A total of 715,000 shares of stock has been issued. The par value is $10 and the present market value $6 per share. It is reported that some of the large shareholders have refused to pledge their stock for 6 and 9 months at the prices offered, and the deal may fail. A short time ago it was reported that English interests were in a position to obtain control of the Lucky Tiger, by the purchase of some stock and a combination with other holders.

CAMBORNE.

Carn Brea & Tincroft.—The loss on the six months ended June 30 was £1937 as compared with a profit of £13 for the previous half-year. The yield was 5lb. black tin per ton less, so it is fortunate that the price of the metal was higher, the average price obtained for the concentrate being £20 more than during the previous half-year. The total receipts were £1152 less, and the expenditure £798 greater, due chiefly to the increased cost of supplies. I give below the chief figures for the half-year :

Ore crushed.....	38,253 tons
Black tin sold	381 tons
Average yield per ton	22·29 lb.
Average value per ton.....	20s. 4d.
Average price obtained for black tin	£102. 10s. 7d.
Total receipts per ton.....	21s. 5d.
Total cost per ton.....	22s. 5d.
Development footage	1637 ft.

From this it will be seen that an increase in the yield of 1lb. per ton will be sufficient to turn the corner; judging by the manager's report, this may reasonably be expected. Furthermore his reforms in the matter of purchasing supplies in the open market and in the methods of mining and concentration will so reduce costs as to provide a substantial margin of profit, always supposing that the price of tin maintains a reasonably high level. In his speech to shareholders, the new manager, E. S. King, expatiated on the necessity of properly segregating mining costs, a question that is neglected at most Cornish mines. In a scattered

property like Carn Brea and Tincroft, it is of the utmost importance that departmental costs should be accurately known. It is gratifying that the company now has a manager who appreciates this point, and I hope his influence in the matter will be felt elsewhere.

Condurrow.—The progress of unwatering this mine is slow. The water is now being held temporarily at the 272 fm. level, so as to enable the whole of the underground force to be concentrated on the work of clearing the 260 and 272 fm. levels. The ore previously left behind in these levels has proved to be richer than that in the upper levels, and Captain Tamblyn believes that it can be treated at a profit. The stamps are therefore being prepared for action once more. The company has had no possible alternative policy, for the capital was exhausted at the end of June, and something had to be done to keep the mine going, while the board considered the ways and means of raising further funds. There is some expectation that the remaining unissued shares will be placed within a short time.

Wheal Vor.—This historic property is still 'marking time,' but the board and others are anxious to have another try at unwatering. The mine is historic, not only as one of Cornwall's great producers, but also on account of the fiasco at the last attempt to unwater it three years ago. The failure on that occasion unquestionably had an adverse effect on the supply of capital for Cornish mines, particularly because the work was being done by an eminent Cornish group, who may be supposed to understand better than any outsider how to handle local mining problems. It is much to be hoped that this fine old property will once more be reopened.

Grenville.—This mine has at last returned to the list of dividend payers, and Captain Battens is to be heartily congratulated in wiping out a debit balance of over £10,000 during his year's tenure of the management. The credit balance on June 30 was £799. At the meeting of shareholders, the board declared a dividend of 4d. per share 10s. paid, and 1d. per share on the shares 2s. 6d. paid. This will absorb about £2250, which Thomas Negus, the chairman, stated had been earned since the closing of the half-yearly accounts. Many people think it would have been wiser to keep the profits in hand as reserve, but the general conditions and prospects are so satisfactory that the distribution is quite legitimate.

GUANAJUATO.

West Kitty.—The yield at this St. Agnes mine continues to be low, but development is being actively prosecuted. Both the Jericho and Friendly mills are working at full capacity, and together treat 600 tons per week. The sale of concentrate at the ticketings averages 14 tons in four weeks, so the recovery is only about 14 lb. per ton. Much of the ore

milled at Jericho comes from the Friendly section of the mine, and is nowadays transported by steam waggon instead of the old carts.

Dolcoath.—The world's oldest tin mine returned a profit of £36,370 for the six months ended June 30 last, during which time 853 tons of black tin realized just over £100,000. The yield was 3·35 lb. higher as compared with the previous six months, but the amount of ore treated was 4344 tons less, owing to the diminished capacity of the mill during the period of changing over from the old Cornish stamps to the air-cushion or 'pneumatic' stamps. The work of equipping Williams shaft is nearing completion, and it is expected that it will be in operation at the end of this month. It will be remembered that the pumps at this new shaft are to be driven electrically, and Cornish mining people are watching the change with interest, not to say anxiety, as was evidenced by the questions asked at the meeting of shareholders. The following figures taken from the half-yearly report may be quoted:

Tons milled	40,315
Yield per ton milled	47·38 lb.
Average price of black tin	£117. 6s. 6d.
Receipts per ton milled	50s. 3d.
Cost per ton milled	32s. 2d.
Profit per ton milled	18s. 1d.

The above working cost includes nothing for depreciation or income tax, which together would account for a further 3s. 4d. per ton milled.

Wheal Coates.—This mine at St. Agnes has been unwatered to the 50 fm. level and a thorough examination is being made from adit to this level. It is nearly thirty years since the water put a stop to operations; at the time work was being done at the 80 fm. level. The owners did not have means to cope with the inflow of water, and in fact they had not worked the mine on any large scale. At the present time the examination is said to be giving satisfactory results and the owners are hoping to be able to raise further working capital. The ore is reported to be clean, as is the case with most mines in the St. Agnes district.

East Pool.—This company has lost its purser and secretary, John H. Mayne, who died last month after being continuously connected with the mine for over forty years. He was to the last a firm believer in the cost-book system, and held that it was as applicable to a big property as to a small prospect. No doubt his influence was strong in preventing any change to limited liability.

NEW YORK.

Stock quotations started a decline on August 2, culminating on the 26th in new low records for the year. Of the 200 issues traded on the Stock Exchange during the week ending August 26, no fewer than 123 shared in this unenviable distinction. This occurred in spite of remarkable activity; in fact, the number of transactions on August 10, when 1,033,630 shares changed hands, was the greatest day's total for the current year. In the short interval from July 29 to August 26, Amalgamated dropped 9⅝; A. S. & R., 10½; Anaconda, 4⅝; Chino, 3¼; Ray, 3½; Tennessee Copper, 7⅜; U.S. Steel com. 9⅜; Utah Copper, 7. Too much speculation seems to be the plainest assignable reason for this big drop in market prices. Assuredly nothing relating to the intrinsic value or earning ability of the several properties can be deduced from the behaviour of the market.

The copper market remains in a condition of stable equilibrium; a lower price is out of the question in the face of increasing consumption and diminishing stocks on hand, and a higher price is unlikely, in the near future, with the possibility of a sudden increase in production when the new mines of the Southwest shall come to their full capacity. The present price of 12½ c. per lb. is likely to be closely maintained for the remainder of the year, unless affected by speculation, in which case the net result will undoubtedly be a rise in price. London speculators appear unanimous in the belief that the price is now too low, from their point of view, and they are waiting for any good excuse to inaugurate a rising market. A peaceable settlement of the Moroccan difficulty is mentioned as one excuse that may be seized upon; another is the report of J. R. Finlay, mentioned in another paragraph, to the effect that the reserves and the future productivity of the Lake Superior mines are not as great as they have been supposed to be, coupled with the statement that, under the inexorable operation of the periodic law, a price of at least 15 c. per pound is practically certain to be reached shortly. When the force of Mr. Finlay's conclusions has been fully considered in London, it may possibly start an upward movement. Copper production in the United States fails to respond to the efforts at curtailment; domestic consumers still hesitate to make heavy purchases; these two causes would combine to reduce prices were it not for increasing exports to Europe. Germany in particular is now consuming enormous quantities of copper, and stocks on hand

have been greatly diminished. In the United States similarly consumers have allowed their stocks, which usually constitute two or three months requirements, to dwindle to almost nothing, and they are now supplying their needs from day to day ; they are, in fact, able to buy spot copper cheaper than that for distant delivery.

Valuation of Michigan mines, which was the task committed to J. R. Finlay, of New York, to be completed within two months of his notification, was accomplished in record time, the final report having been handed to the State Board of Tax Assessors on August 21. The report is to be printed and will become public in a few days. From proof-sheets in Mr. Finlay's office it is learned that the three factors considered in valuing each individual mine were (1) Price received for product ; (2) Cost of production ; (3) Life of mine. From the first two data, the net profits could be computed, and this, combined with the third factor, permitted an estimate of the present value, by annuity method. In the present case, a sum was calculated upon which the series of dividends would pay 5% interest and also provide each year a sinking fund instalment which, invested each year at 4%, and added to prior instalments similarly invested and re-invested would equal the sum taken. This sum is the account which an investor can afford to pay for the property.

On this basis Mr. Finlay values the copper mines of Michigan as follows : Keeweenaw county, $12,200,000 ; Houghton county, $57,315,000 ; Ontonagon county, $300,000 ; total, $69,815,000. The iron mines are similarly valued as follows: Gogebic, $41,560,000; Iron, $23,339,000 ; Dickinson, $11,508,000 ; Baraga, $3,381,000 ; Marquette, $42,743,000 ; total, $119,485,000. The coal mines of the State are valued at $861,745. After due consideration Mr. Finlay recommended that the salt, gypsum, cement, and clay operations be considered as manufacturing rather than as mining enterprises, and, therefore, not to be included in the present valuation. During the last five years, on which period the present investigation was based, the profitable copper mines of Michigan earned $50,937,690 over expenditure, but these earnings are considered abnormal, owing to the spectacular prices of copper during 1906 and 1907. Thus in 1906 the net earnings were $21,093,000, whereas in 1910 they were only $7,075,000. During the same five years, the iron mines of the State made net earnings of $57,551,202, without the benefit of abnormal prices ; in fact, the earnings of 1910 were above the average of the five years. The total valuation of the iron mines, $119,485,000, is based on an expected annual tonnage of 10,922,000, with a present total estimate reserve of 195,041,809 tons. While this tonnage is all that can now be apportioned among the various properties with any degree of certainty, the several districts are expected to produce ore somewhat as follows: Marquette, 150,000,000; Menominee, 150,000,000 ; Gogebic, 60,000,000 tons.

GOLD BAR MINE AND MILL, RHYOLITE, NEVADA

Appraisal of Mines.—In explaining his method of appraisal, Mr. Finlay takes a firm stand on the following three propositions, per-

fectly reasonable to a thoughtful engineer, but often overlooked by the investing public: (1) Unprofitable mines have no value, and were appraised at zero; (2) Stock-market quotations are not reliable as a means of determining the value of a mine, and in the present investigation were totally ignored; (3) Mining plants have no value apart from the orebodies that they serve, and were therefore not appraised. In estimating the expected net proceeds of the Michigan copper mines, Mr. Finlay confidently adopts 14c. per pound as a conservative estimate of the price of copper for the next 10 years, but expresses his personal opinion that the price will exceed 15c., and establishes his conclusions by comparison with preceding decades. The forthcoming production from the new porphyry mines of the West should cause no uneasiness, in as much as the world's consumption is increasing at the rate of 100,000,000 pounds per year, which will counterbalance the expected increase from the porphyry mines in about three years, at the end of which time conditions will again be favourable for high-priced copper.

SALT LAKE CITY.

Copper.—Unless there is a sudden and unexpected change in the scope of operations at the Utah Copper, a heavy increase in production may be anticipated in the immediate future. Mine and mill are ready for it. At the mine 18 steam-shovels are at work removing the overburden and taking out ore, handling a total of about 50,000 tons of ore and waste daily. The report for the quarter ending June 30 shows that a total of 1,395,504 cubic yards of cap was handled in the three months. The Bingham & Garfield railroad, built to haul the ore from the mine to the mill and smelter, is practically completed, and will be in full operation shortly, when all the rolling stock has arrived. This will afford ample facilities for hauling all the ore the mine can produce. At the mill, the remodelling of the Arthur or old Boston Consolidated plant is progressing. It is given out officially that the four remodelled sections will handle as much ore as the entire original thirteen, and that the two plants, Arthur and Magna, will soon be in shape to take care of 20,000 tons of ore daily. An interesting announcement in the last quarterly report opens up an old controversy. This is to the effect that the Utah Copper has permanently abandoned the use of stamp-mills for the crushing of porphyry ore. When the Boston Consolidated mill was designed by A. J. Bettles (who died recently), he caused surprise by installing stamp-mills to handle the low-grade copper-bearing porphyry. The great problem was to crush fine without sliming, and Mr. Bettles' experiments had convinced him that this could best be done by the stamps, paradoxical as the idea seemed. The original Utah Copper plant (now the Magna) was being built about the same time, and many comparisons were made in favour of the Bettles method. Mill-men familiar with both plants during their early period of operation declare that the Boston Consolidated was making a much better saving at a lower cost with the same or a lower grade of ore. This was taken as one of the grounds for criticism of the Utah Copper management. When the Utah Copper obtained control of the Boston Con. and merged the two properties, the management began systematically to discredit the use of stamps. Various reports have been circulated, that the old Boston Con. or Arthur plant was not giving such satisfactory results as the old Utah Copper or Magna plant, and that it was necessary to remodel it along the original Utah Copper lines. This is being done, and the stamps are now abandoned, but despite the announcement that a 70% is being made, there are many competent mill-men who still would pin their faith to stamps if they had the problem of designing a plant to crush porphyry ores similar to those at Bingham.

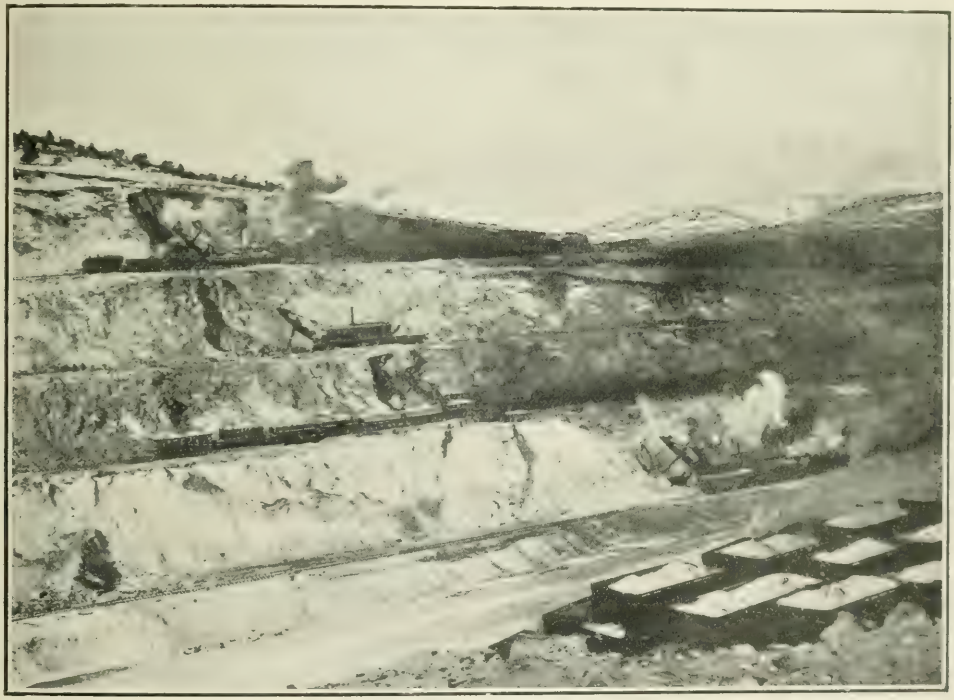
A large amount of development work is in progress at the Utah Consolidated, and a considerable tonnage of low-grade copper ore is being opened up. This is being encountered between the 1000 and 1100 levels.

Nevada Consolidated showed a falling off from 15,893,743 pounds of copper for the previous quarter to 15,677,065 lb. for the quarter ending June 30. The decrease is explained by the fact that it was necessary to remove a large amount of low-grade material for the construction of tracks. This was too valuable to waste, and so it was all sent to the mill, bringing the average for the quarter down to 1·59%, the lowest since operations were begun.

Lead-silver properties all through this part of the country are receiving an impetus through the competition of the smelters for this class of ore. The new lead plant of the International Smelting & Refining Co. at Tooele will soon be in operation, and all the smelting companies are scouting for contracts. In consequence, inducements are being offered for ores of a lower grade than it has been possible to ship heretofore. This makes available several millions of tons of ore

hitherto left in the mines or thrown over the dumps. For example, the May Day mine at Tintic recently made a contract enabling it to ship ore running 7% lead, 7 oz. silver and $3 in gold. It will ship ore from its dumps and slime from the concentrator that have accumulated for a period of years.

Pioche, Nevada.—After long negotiations, undertaken by various sets of owners over a period of many years, a consolidation has been finally effected of some of the leading mines in the heart of this district, which could not profitably be worked at depth without co-operation. The Amalgamated Pioche Mines & Smelters Corporation has acquired the properties of the Nevada-Utah, Ohio-Kentucky, and Consolidated Pioche. As far back as 1876, efforts were made to bring some of these properties together, in order to handle the water problem, but only bitter quarrels ensued, resulting in the practical abandonment of the camp for many years. The Nevada-Utah interests are now in control of the amalgamated property. A $500,000 bond issue has been financed and active development work at depth is already under way. The new company controls about 1000 acres of ground, including some properties from which over $20,000,000 in silver-lead ores has been extracted.



MINING COPPER ORE AT THE NEVADA CONSOLIDATED.

MELBOURNE.

New South Wales.—The full report of the Department of Mines of New South Wales for 1910 is a satisfactory document inasmuch as it discloses that minerals to the value of £8,736,000 were won as against £7,636,000 in 1909. The increase is partly due to coal, the output being 8,173,000 tons of the value of £3,009,000; zinc, 468,627 tons, value £1,290,000; silver-lead ore, 318,000 tons, value £1,685,000. The high price of tin has prevented any shrinkage in the value of the output although the tonnage was less. Copper, with a yield of 12,890 tons of a value of £486,000, shows an increase. Taken generally the figures fail to indicate the strength of the mineral position of the country. What Australia wants is extra population; in fact, the magnificent coal seams of New South Wales alone should yield fuel equal in value to that of the whole of the present mineral output of the State. The yield of gold is declining and will fall still more as the dredging industry becomes restricted. Alluvial tin also is being exhausted and lodes are not filling the

gap, but there are a number of low-grade copper formations, which if labour were less costly would pay to work; as it is, however, they have to lie idle. This is also the position with a large number of small lead and zinc properties. Still more does the remark apply to the large bodies of iron ore in different parts of the State. The labour party does not want population because its leaders fail to recognize that large population means large employment.

Broken Hill.—The mining industry at Broken Hill is in a flourishing condition. A splendid discovery has been made at the British mine which property was floated in London within two years of the discovery of the Barrier range in 1886. The British blocks comprise the two northern claims owned by the Broken Hill Proprietary Co., and were taken to London by William Knox, the belief being that the orebodies in them would make the flotation a huge success. Unfortunately it was found that the big shoots of ore petered out at a shallow depth, and although there have been in-and-out periods of prosperity, owing to finds here and there on the two big claims, no discovery of importance has been made since the early days. Now, however, off Thompson's shaft just in the middle of the property, the presence of a new shoot of ore has been disclosed. At 800 ft. a stope 110 ft. wide has been developed. At first this was thought to be a portion of the eastern vein, a somewhat narrow shoot of ore that persists the whole length of the property, in some places as much as 40 ft. in width, and at others only 10 ft. To prove the extent of the shoot boring was started in the 600 ft. level above, with the result that a length of over 400 ft. of ore ranging up to 154 ft. in width and of high value was proved. Drilling is now being done at the 500 ft. level and ore has been found, while at 900 ft. after opening the plat and cross-cutting a few feet ore has been met. No work has been done overhead in this shoot from the 800 ft. level, so that there is practically a new mine. For 25 years different managements have been in search of a find of this kind, but it was only when the last corner left untouched was entered that the discovery occurred. The greatest praise is due to the manager, W. H. Woodhead, for his belief in the property and his determination to test this part of the ground before finally saying that he could see the end of the ore reserves.

At the North Broken Hill mine ore has been struck at the No. 12 level (1250 ft.). Judging from the extent of the orebody in the adjoining Junction North mine, this level, if nothing untoward happens, should be highly productive. A still more interesting development is the opening up at the Central mine of the Sulphide Corporation, at the south end of the range, of a fine body of ore at the No. 12 level. This orebody is pitching into the South Broken Hill mine, the value of which is enhanced accordingly.

The zinc industry is doing exceedingly well, owing to the success of the flotation processes. They now are treating slime as well as the ordinary residues. Indeed, the Junction North Co. has just purchased 275,000 tons of slime at prices ranging up to 8s. 6d. per ton. Two years ago the idea of buying this material for treatment at all would have been scouted unless by the method of sintering for smelting in the lead furnaces. That, of course, would mean a loss of the zinc content. Now this treatment by flotation, and especially by the Minerals Separation process, means that the zinc is saved and a considerable percentage of the lead. The Broken Hill Proprietary Co. is now treating slime by what is virtually the Potter process. The ten zinc furnaces will be at work shortly, as all difficulty with respect to clays has been overcome. The labour available is being put on the bonus system and the expert brought by the company from Europe to instruct the staff is highly gratified with the progress made by the workers, their intelligent aptitude being striking. Some of the mining men at Broken Hill question the wisdom of the company spending £100,000 in the erection of the zinc works. The officials however are satisfied that they will be able to show highly profitable results. There is a local market for spelter, and the East can be looked to for a market for the surplus. The Iron Knob iron ore deposit may be exploited and galvanized iron made. Though nothing definite can be learned, the impression is that the directors have a large industrial programme ahead. Hence G. D. Delprat's visit to Europe. If so the company is not the dying giant that many people would describe it as being.

Export Duties.—In New South Wales the dominant labour party is being asked to take steps to induce the Federal parliament to impose an export duty on lead and zinc concentrates. This matter has been alluded to before in these columns, but now those moving have come more into the open. The large works erected at Port Kembla partly by the Mount Morgan interests are known to be interested in this movement.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

August 1911.	July 1911.	August 1910.
£56. 7s. 6d.	£56. 15s. 6d.	£55. 17s. 5d.

In spite of political nervousness in Europe and labour disturbances, copper has shown a noteworthy steadiness of price. While the prices of securities and of the leading commodities have slumped, metals generally and copper in particular have been little affected, although the volume of business has naturally decreased. During the greater part of the month England entirely ceased buying and continental purchases although fostered by concessions from the American producers have only been moderate. Speculators remain shy. The statistical position is felt to be not altogether encouraging. In Europe there was the first increase for eighteen months in the visible supplies, while the decline in American stocks for July was due entirely to a decrease in refinery output brought about by the abnormal heat. There is still no improvement in the domestic consumption in America and the expectations of an autumn revival in trade show no signs of being realized. The situation however gives no encouragement to bears.

TIN.

Average prices of cash tin:

August 1911.	July 1911.	August 1910.
£190. 9s. 7d.	£193. 2s. 0d.	£155. 8s. 2d.

Tin has been quieter than has been the case for some time past. The syndicate seems still to have control, but its operations are less aggressive than of late, and the real position is obscure. Business with America was suspended for a time as the strikes made transhipment in London impossible, and in consequence an artificial advance was established in America until timely arrivals from the Straits relieved the situation. Speculation has almost ceased. The tinplate industry is still fully occupied and is absorbing a large tonnage of metal. The East has been a moderate seller during the whole of the month, and has obtained good prices from America. The fluctuations in the London market, though still considerable, ranging between £196 and £187. 10s. for cash, are less violent than recently. At one time there was rather a flurry for spot metal to fulfil contracts where the strike made it impossible to land tin from import steamers, but the offerings became liberal and the advance was not maintained.

SPELTER.

Average prices of good ordinary spelter:

August 1911.	July 1911.	August 1910.
£26. 11s. 1d.	£24. 13s. 10d.	£22. 14s. 0d.

The strength of this market, to which we have drawn attention during the past few months, culminated in a sensational rise of £2 per ton during August. Supplies have been so inadequate that consumers were willing to pay almost any price. Galvanizers have advanced prices of sheets and the demand may be somewhat checked thereby. So great a rise in so short a period should make buyers pause and ask themselves if the advance is not overdone. It is quite possible that in spite of the demand and the limitation of production, £27. 10s. may mark the crest of the wave.

LEAD.

Average prices of soft foreign lead:

August 1911.	July 1911.	August 1910.
£14. 1s. 4d.	£13. 10s. 11d.	£12. 10s. 9d.

The stronger tendency in this market is gradually being realized by the trade. The consumption is fully up to the highest records but production has undergone a considerable falling off. The Mexican trouble, strikes in Spain, and the scarcity in shipping tonnage make it difficult to bring forward sufficient supplies for the requirements of the London market. As much as £14. 11s. 3d. for foreign has been paid for early delivery ex ship and consumers are poorly provided beyond September. At the London desilverizing works, a strike continued during the whole month and has further curtailed supplies. Continental demand is large as usual before the close of Baltic navigation. It seems inevitable that the advance must continue and a considerably higher level of prices must be attained.

OTHER METALS AND MINERALS.

Prices quoted on September 9:

SILVER.—24¼d. per oz.

PLATINUM.—178s. 6d. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£59 per ton.

NICKEL.—£170 per ton.

COBALT.—9s. 9d. per lb.

ANTIMONY.—£27 per ton.

QUICKSILVER.—£8. 12s. 6d. per flask.

MANGANESE ORE.—8d. to 9½d. per unit (1%).

IRON ORE.—Cumberland hematite 19s. 6d. per ton at mine. Spanish 19s. delivered.

PIG IRON.—Cleveland 47s. per ton. Hematite 62s. per ton.

WOLFRAM ORE—31s. per unit (1%).

DEEP MINING ON THE RAND

By ROWLAND GASCOYNE.

THERE seems every prospect that the Rand goldfield will be exploited to a greater depth than any other mining district in the world. Already several of the Rand mines rank among the deepest gold mines of the world, and no apparent definite limit to mining appears as yet within sight. There are several reasons why the Rand may be expected to establish a world's record in deep mining, such as low increase of temperature with depth, excellent underground conditions, and unusual facilities for obtaining cheap electrical power.

It is an important fact that the underground temperature on the Rand increases with depth slower than in any other goldfield, and much slower than in any known coalfield. About two years ago Mr. Lionel Phillips, at a Chamber of Mines meeting, gave some particulars of observations taken at several of the deepest mines. These showed that up to a depth of 4420 ft. the temperature increased on the average 1°F for every 255 ft. of depth. There were some anomalies, it is true, the highest temperature recorded being 84½°F in the Brakpan mine at 3640 ft. from the surface, while at the depth of 4420 ft. in the Jupiter mine the temperature was only 81°F, but judging from the average increase shown by a large number of observations, that at the Jupiter was more nearly correct. The underground temperature conditions on the Rand seem to be approached only by some mines in the United States, where mining operations are conducted at about a thousand feet deeper. Generally speaking the rock temperature increases in coal mines at least 1°F for every additional 60 ft. in depth. To show how Rand conditions are conducive to deep mining, it may be pointed out that a depth of 4500 ft. has been reached without any attempt at artificial ventilation. This must be considered unique in the annals of deep mining. At the present time, however, for health considerations alone, many of the outcrop as well as the deep-level mines are being fitted with ventilating fans.

Another valuable asset possessed by the Rand goldfield when deep mining possibilities are considered is the unusually favourable country rock prevailing over the greater part of the district, especially the excellent quartzite lode-walls. In the Far East Rand, the footwall, it is true, is formed of slate, a condition less conducive to deep mining than quartzite owing to its inability to carry weight-strains to the same extent as quartzite. Some years ago the Johannesburg municipality made several tests, in order to arrive at the strength of the quartzites on the Central Rand, and, generally speaking, the experiments went to show that the weight they would carry without fracturing bore a close relation to their specific gravity. Out of a dozen quartzites tested it was estimated that the average depth at which the weight of the superincumbent strata would approach the limit of capability to resist fracture would be in the neighbourhood of 3690 ft., while some of the hardest quartzites would not fracture, under similar conditions, until a depth of 5567 ft. was reached. Naturally at shallower depths than these, in actual mining operations, pillars would be liable to fracture, owing to the increased weight thrown on them by mining operations, and instances are known where they have thus fractured, at less depth than those already mentioned, owing no doubt to the pillars having to carry the weight of the superincumbent strata over the adjacent exhausted areas. It must be noted that these remarks are based upon the pressure necessary to fracture quartzite, and it may be that the beds of banket vary but little in their capability to withstand pressure as compared with quartzite, and have therefore been considered accordingly. Judging however from the action of shale when subjected, along with quartzite, to lateral pressure, of which instances may be seen in the Lower Witwatersrand division, the footwall shale in the Far East Rand must be regarded as an element of weakness when deep mining possibilities are considered, because they will fracture and yield at a much lower pressure than that to which an ordinary quartzite will succumb.

Quartzite from the Robinson mine at a depth of 3500 ft. showed fracture at a pressure of 6804 lb. per sq. in., and crushed at a pressure of 9029 lb. per sq. in. The danger zone is reached when fractures begin to show, so that 7000 lb. pressure per sq. in. would probably be somewhat near the point at which the quartzite of the present deep mines would

CINDERELLA DEEP MINE, 4500 FT. DEEP.

fracture. With a pressure of 10,000 lb. per sq. in. they might be expected to crush. Now a column of quartzite one square inch in area gives a weight of 1222 lb. for every foot in depth, and this fracturing pressure of 7000 lb. would therefore be reached at a depth of 5728 ft. The crushing stage would probably be reached in the neighbourhood of 8000 ft., that is, provided the whole of the weight of the hanging wall was moving, so that the maximum pressure was exercised by the hanging wall. In coal mining a similar condition of affairs would be produced at a depth of 2000 feet only.

Little, however, seems to be known about the action of the Rand hanging walls. In coal mining, where the roof consists largely of shale, and the method of working is long-wall, the total extraction of the seam soon shows its effect at the surface. Whereas on the Rand, the hanging wall consists of hard metamorphosed sandstone, much less flexible than shale or slate. This has a tendency to move in large blocks, and a much longer period will probably expire before the effects of mining are experienced at the surface than would be the case with more flexible roofs. In time, however, the result of the total extraction of the banket lodes on the Rand must invariably reach the surface, but the greater time required to set the hanging on the move is undoubtedly a great advantage to mining operations. If underground operations are to be conducted so as to render the movement of the hanging wall totally impossible, as many engaged in mining in this locality believe possible, then at a depth of 2000 ft., nearly a third of the lode would have to be left in the shape of pillars, to produce absolute security from any fracture or movement in the hanging wall. At a depth of 3000 ft., it would be necessary to leave fully one-half in the shape of pillars, to produce the same results, while at a depth of 6000 ft. from the surface it will become impossible to mine without running the risk of the hanging wall ultimately moving, and fracturing any pillars that may be left behind. From these estimates it would appear that mining operations can be conducted on the Rand at least three times deeper, without setting up the same conditions, than in coal mining, and as the limit to payable mining at collieries is fixed at 4000 ft., the equivalent maximum depth on the Rand, other conditions being equal, would be in the neighbourhood of 12,000 ft. But then again the economic conditions of gold mining are quite different from those of coal mining, and are moreover altogether in favour of the former. For instance, in the case of coal mining, it is estimated that at a depth of 4000 ft. not only would the temperature be too high, but the pressure of the superincumbent strata would be so severe, as to reduce the proportion of sound coal produced to such an extent as to make mining well nigh unprofitable. In gold mining this reduction of the output to small dimensions has less terrors and, on this account, it would seem impossible to place any limit to deep mining on the Rand, by reason of the effects of the pressure of the superincumbent strata. The difficulties caused thereby can be dismissed from further consideration, provided however that the ore is worked on a system approaching that of long-wall, and sand-filling on an extensive scale is adopted.

The question of underground temperature as an obstacle to deep mining on the Rand has been already discussed, and it has been shown that the increment with depth is probably lower than in any known mining region. If the result of the latest observations be taken into consideration, and due allowance be made for the cooling effect of ventilation, the same temperature will not be reached on the Rand until a depth of at least 12,000 ft. from the surface has been attained. Again, in its coloured labour the Rand possesses an advantage by no means negligible, for these native workers will be able to maintain their efficiency, such as it is, in a temperature much higher than that to which European or white labour of any description could submit.

An impression prevailed not long ago that the most formidable obstacle to deep mining on the Rand was that of deep winding. At that time the application of electricity to mining operations was in its infancy, and it was not foreseen that the Rand, with its cheap coal and sufficient water, would offer an excellent field for the production of electrical power at such a low cost as a farthing per unit. For convenience, efficiency, and cheapness, the Rand therefore possesses just the agent to solve the deep winding problem. It has been decided that the best plan is to adopt stage-winding. The limit to deep winding from an economic standpoint being fixed at 3000 ft., it has been decided to adopt this depth as the limit for each stage. This proposal has been adopted by all the large mines with extensive areas on the dip, and main levels are being driven throughout the whole length of the properties, which are intended to be fitted with modern haulage arrangements so as to act as feeders to the shafts. The shafts are being fitted so as to hoist from

4000 tons to 6000 tons during the shift of 10 hours. This then is the proposed solution to what appeared the most difficult problem in connection with deep mining on the Rand, but it is evident that without such a handy and cheap power as that of electricity, any other solution on similar lines would have been clumsy and costly to effect.

With a low temperature-gradient, sound rock-walls, and cheap electrical power, there is therefore every prospect of deep mining being unhindered. The ultimate depth, however, to which mining operations on the Rand will be carried is difficult to fix, because there are other important factors to be taken into consideration in addition to those already mentioned. It is clear that deep mining will only be carried on so long as it is profitable, and as this depends upon the grade of the ore, which to a large extent cannot be ascertained until actually exposed, it becomes impossible to fix a definite limit. An impression seems to be abroad that the lodes of the Rand become impoverished in depth; undoubtedly in some cases they do, but in others they improve, and perhaps the most correct view is to regard them as always liable to change, inasmuch as low-grade areas will continue to alternate in depth with richer areas, just as they have done during the last fifteen years. Actual past yields constitute no reliable guide, as they have always been subject to manipulation, to obtain the best results either in the shape of high profit or low working cost. On the whole there seems no reason to expect that the average assay-value will drop below 5 dwt. per ton for many years, and at this yield the Rand mines ought to be worked at a profit, since the average working cost will decline rather than advance with increasing depth. The conclusion then is that temperature, rock-pressure, and deep-winding problems offer little difficulty to mining on the Rand down to a depth of ten or twelve thousand feet, and the only real difficulty is that of ore-value, for which there is of course no artificial solution. Should the ore maintain its present average value and working costs decline, as seems probable, he would be a bold engineer who would venture to fix a depth beyond which it will be impossible to carry on mining operations on the Rand.

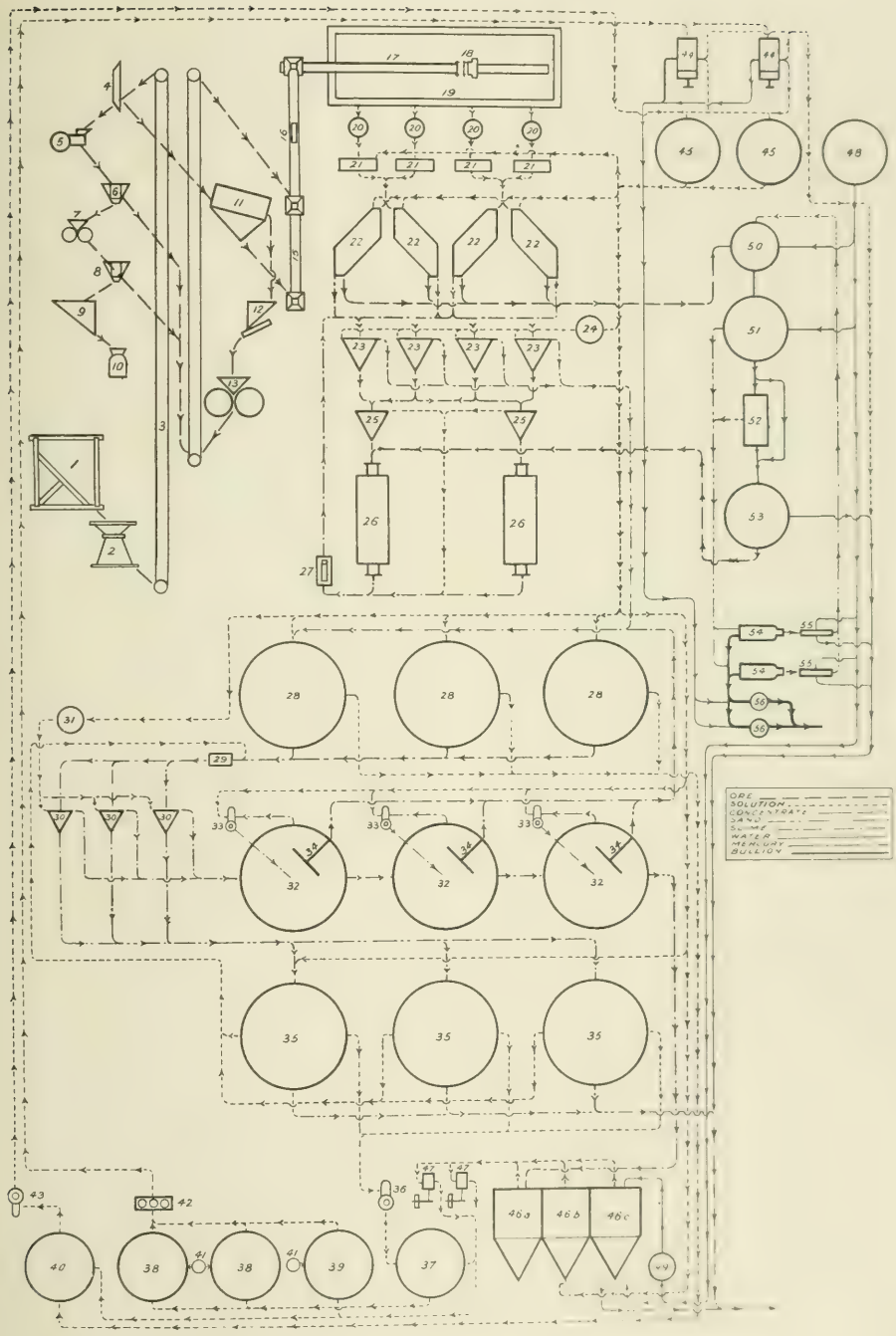
RAND COLLIERIES GOLD MINE, 3000 FT. DEEP.

Cyanidation of Silver Ore at Cobalt.

Until recently the silver-bearing ores and concentrates of Cobalt, Ontario, have been sold to smelters, and we have given particulars of the method and terms of sale of the various qualities. During the last year or two several of the managers have turned their attention to the applicability of the cyanide process as an alternative method of beneficiating the ores. We are able by the courtesy of Mr. A. G. Kirby to give herewith the flow-sheet of the cyanide plant designed and erected by him at the Nova Scotia mine. This mine was not one of the surface bonanzas, and it was only after much prospecting and development that profitable lodes were disclosed. Some of the ore is found in small veins of calcite that carry metallic silver, smaltite, niccolite, and sulphides of bismuth, but most of it consists of thin sheets of silver distributed through the country-rock, diabase. The rock is extremely hard and tough. In mining, the lumps of silver are picked out in the stopes as the ore is broken, so as to avoid trouble in the crushers. The ore is first reduced to 2 in. size in a Hadfield gyratory machine (*2*) and then elevated to a trommel (*11*) with 1½ in. holes, the oversize going to rolls (*13*). An elaborate system of sampling is provided, as shown in the illustration. The ore is then sent to 20 stamps of 1500lb. each (*21*) dropping 96 times per minute, with screens of 16 mesh. Cyanide solution is used in the battery. The pulp is delivered unsized to four No. 2 Deister tables (*22*) for the removal of the 'metallics' and rich sulphides. No effort is made to make a close saving by concentration, the object being to remove such material as requires a relatively long time of contact with cyanide solution, and thus to keep the size of metallic silver particles within the time-range of the continuous agitation, the average cycle of which is 72 hours. The concentrate is consequently rich, running from 2500 to 5000 oz. per ton, the ratio of concentration being from 80 or 100 to one. It is charged into a 5 ft. amalgamating pan (*50*) in 1500 lb. charges and ground with the muller down for 8 or 10 hours. The muller is then raised and from 900 to 1200 pounds of mercury is added; the pan continues to run 3 hours more with the muller raised. The tailing from the concentrate is dewatered and passed into the tube-mills (*26*) there joining the mill-flow.

The tailing from the Deister tables goes to 4 rectangular, double-cone, hydraulic classifiers (*23*). From here the coarse material goes to the tube mills (*26*) and the fine direct to the cyanide annex. The overflow from the classifiers (*23*) goes to three Dorr thickeners (*28*) and the thickened pulp is classified into sand and slime, the former going to vats (*35*), and the latter to Trent agitators (*32*) arranged in series. The Trent agitator is a flat-bottomed vat. Circulation is effected by means of a centrifugal pump which draws the solution away from near the surface and delivers it through a central axis into four arms arranged about 18 in. above the bottom. These arms have each a row of nozzles along one side and the issuing jets cause them to revolve slowly. The final discharge from No. 3 goes to Moore filters (*46*). The Merrill zinc-dust precipitation process is employed (*44*). The overflow from the Dorr thickeners goes to the Merrill plant also, as much gold being removed as possible. It is interesting to compare this method of treating Cobalt silver ore with that adopted at the McKinley-Darragh mine, described briefly in our Précis of Technology.

Complete references to the flow-sheet are given herewith: (*1*) Mine-ore bin; (*2*) gyratory crusher; (*3*) 10 in. elevator; (*4*) Snyder sampler 10%; (*5*) Blake crusher 8 in. by 12 in.; (*6*) Vezin sampler 10%; (*7*) rigid rolls 24 in. by 12 in.; (*8*) Vezin sampler 10%; (*9*) two-compartment bin; (*10*) sample bell grinder; (*11*) 3 by 10 ft. trommel; (*12*) plunger feeder; (*13*) 30 by 10 in. spring rolls; (*14*) 8 in. elevator; (*15*) 16 in. belt conveyor; (*16*) automatic scale; (*17*) 16 in. belt conveyor; (*18*) automatic tripper; (*19*) mill-ore bin; (*20*) Challenge feeder; (*21*) twenty 1500lb. stamps; (*22*) four No. 2 Deister tables; (*23*) four Kirby classifiers; (*24*) 3 by 3 ft. equalizing tank; (*25*) two 3 ft. dewatering cones; (*26*) two 4 ft. 6 in. by 18 ft. tube-mills; (*27*) 8 by 54 in. Frenier pump; (*28*) three 24 by 10 ft. Dorr settlers; (*29*) 8 in. elevator; (*30*) three Kirby classifiers; (*31*) equalizing tank; (*32*) 24 by 12 ft. Trent agitators; (*33*) three 3 in. Morris agitating pumps; (*34*) three 3 in. decantors; (*35*) 24 by 6 ft. sand vat; (*36*) Price centrifugal pump; (*37*) clarifying tank; (*38*) two 16 by 16 ft. precipit. sol. tanks; (*39*) 12 by 10 ft. waste solution tank; (*40*) 12 by 10 ft. unprecip. sol. tank; (*41*) Merrill's zinc feeder; (*42*) 7 by 9 in. triplex pump; (*43*) 3 in. centrifugal pump; (*44*) two Merrill filter-presses; (*45*) two 18 by 12 ft. solution storage; (*46*) Moore filter-press; (*47*) two 7 by 10 in. vacuum pumps; (*48*) 24 by 20 ft. water storage; (*49*) 8 by 10 ft. equalizing tank; (*50*) 5 ft. grinding-pan; (*51*) 8ft. settler; (*52*) 54 in. by 10 ft. amalgamating plate; (*53*) 6 by 6 ft. settling tank; (*54*) 12 by 48 in. retorts; (*55*) condensers; (*56*) Steel-Harvey furnaces.



FLOW-SHEET OF THE NOVA-SCOTIA CYANIDE PLANT, COBALT.

PERSONAL

G. B. ADENEY sailed on August 23 for Cape Town on his way to Johannesburg.

J. G. BOWER is in London on his way from Mexico to South Africa.

J. E. BREAKELL is at Tegucigalpa, in Honduras.

C. R. CORNING sailed for New York on the *Amerika* on August 30.

C. D. COSBY is in the island of Sakhalin.

A. SPENCER CRAGOE, of Bruce Marriott & Co., sailed for Brazil on September 8.

EDWARD H. CROGHAN, lately on the Rand, is at Cambridge.

GEORGE A. DENNY is expected in London from Mexico on September 14.

R. FARINA, for Pearse, Kingston & Browne, is on his way to Central Siberia.

ROWLAND FEILDING left for Newfoundland on August 26.

GEORGE H. GARREY has opened an office at San Francisco as a consulting mining geologist.

ERNEST GRAVE has left Pinos and is now at Tampico, Mexico.

HARRY D. GRIFFITHS, the manager of the Tronoh Mines, sailed for the Malay States on September 2.

T. M. HAMILTON, formerly at Asientos, is now superintendent of the American Smelting Co.'s plant at Charcas, Mexico.

KUNO B. HEBERLEIN is here from Mapimi, Mexico.

W. M. HENDERSON SCOTT is here from Colorado.

C. S. HERZIG is at Iquitas, Peru.

ROSS B. HOFFMANN and SCOTT TURNER sailed for New York on September 8.

H. C. HOOVER and A. C. BEATTY left for Kyshtim, Siberia, on September 6.

J. D. HUBBARD is now superintendent for the Chosen Mining Co., in Korea.

LOUIS D. HUNTOON, until recently professor of mining and metallurgy in Yale University, has opened an office at 42 Broadway, New York.

H. H. JOHNSON and J. I. HOFFMAN have gone into partnership, with offices at 216 Moorgate Station Chambers, E.C.

JOHN T. KEATING has gone to Kano, in Northern Nigeria.

F. F. KETT is in London, on his return from Chile.

FRANK LANGFORD has returned from Chile and is at Eureka, California.

THOS. H. LEGGETT is in the Yukon Territory.

ERNEST LEVY has returned to British Columbia.

A. G. MACDONALD, of Dunedin, N.Z., is in London.

GEORGE MACFARLANE has been appointed manager for the Wallis Syndicate in West Africa.

C. H. MACNUTT left London for Buenas Ayres on August 4 to resume charge of the Poderosa mine, in Chile.

EDWARD T. MCCARTHY has returned from Porcupine.

J. W. MERCER is in the Idatarod district, Alaska.

A. E. PARKER has gone to Medellin, in Colombia.

CYRIL E. PARSONS is at Bulawayo.

WALTER G. PERKINS has returned from Kyshtim.

FRANK H. PROBERT was at Cananea, Mexico, in August.

THOMAS PRYOR sailed on September 9 for India, to be surveyor of the Ooregum mine.

C. W. PURINGTON, D'ARCY WEATHERBE, NORMAN C. STINES, W. H. KNOX, and H. G. HANN are examining dredging areas in Eastern Siberia.

THOMAS T. READ, associate editor of the *Mining and Scientific Press*, was recently at Ely, Nevada.

FORBES RICKARD is at Valdez, Alaska.

JAMES A. RICKARD, of Toulouse, recently manager of the Villaniere gold mines in France, made a visit to London.

W. ROBERTS is in Egypt.

F. F. SHARPLESS was recently at Seward, Alaska.

S. F. SHAW has resigned as manager of the Montezuma Mines of Costa Rica.

A. L. SIMON has returned from the Ural Mountains.

RICHARD B. STANFORD concluded his visit in London and is now at New York.

HENRY F. STRANGWAYS is in the Morococha district of Peru.

A. ERNEST THOMAS is in Portugal. He expects to return to London at the end of September.

E. COPPEE THURSTON has come from New York to accept the post of mining engineer to A. Goerz & Co., in London.

H. L. TWITE, of Twite & Steinhart, was in Norway recently.

H. H. WEBB sails for New York on September 29.

MORTON WEBBER is in Mexico.

THE FINANCE OF A MINE. IV.

By M. H. BURNHAM.

THE first article of this series dealt with the basic concepts of investment, namely, the necessity for considering the return of the capital and a rate of interest commensurate with the risk. The second paper developed these premises as applied to the ore reserve and sought to prove that the ore in a mine should be valued on the same principle, that is, the risk-rate should vary for each block inversely with the available data or number of sample sections. The expansion of this idea also demonstrated the need for regarding as a reserve the ore lying below the deepest level to a point governed by the above idea and determined by the formula submitted. The third article dealt with the ore still below the above point, that is, the possibilities of the mine, and sought to establish a "unit of possibility" wherewith to compare the economic magnitudes of different deposits, aside from the reserve in each, thereby furnishing a criterion of valuation practice.

As will have been seen, all the foregoing is the outcome of a development of the simple business axiom that the greater the risk the greater the rate of interest to be demanded, whether the comparison be between different financial ventures or blocks of ore in the same mine in different stages of development. The present and succeeding articles take up the above concept in conjunction with that of deferment, which last is of course nothing more than the demand that the returns when available shall make up the losses due to the nonpayment of dividends during the deferred period and extend the application of this principle, with the one foregoing, to the valuation of each block. The present chapter deals with the practical significance of what is known in actuarial parlance as deferred annuities; this, if the risk-rate idea be accepted, assumes a rôle the importance of which appears to have been entirely overlooked in metal mining, though recognized in Early Victorian coal-valuation practice.

Unpleasant as may be the admission, the modern engineer has perforce to allow that our grandfathers had a firmer hold on the economic bases of finance than we have. So badly weighted are the curriculums of technical institutions that men are turned out not only ignorant of the basis of industrial finance but too often sadly wanting in a sense of economic proportion. As a matter of fact the ordinary engineer when first launched from a School of Mines is generally a pseudo-scientific dreamer, and in spite of wonderful opportunities in the way of varied experience, it requires many years to counteract the vicious defects of his early instruction. As mentioned before, although the engineer's ordinary work may be little concerned with the economics of finance, when he has to advise in a negotiation or is consulted with regard to the value of shares the whole subject calls for the closest attention. Furthermore, the growing practice of placing engineers on the directorates of public companies confirms the above view with regard to the need for a knowledge of finance, and the choice of men of character and ability indicates a tendency to allow the ordinary tenets of commercial faith to supersede the exigencies of an optimism nicely surcharged for promotional purposes.

As indicated before, the significance of deferment is sadly overlooked not only in the case of the simplest calculations but in more complex problems, among which might be mentioned those of industrial ethics. For instance, the not uncommon phenomenon of the financially vicious forsaking devious ways for the paths of financial virtue may be said to be a deferment of profit to be secured later in the shape of civic honour, titled or otherwise. According to my own observation, the shares or interests taken by promoters in many mining flotations is too small when one considers the inevitable loss of time and money incurred by them in fruitless examinations. Twenty per cent. may not be too much in the case of a successful venture to recoup the many failures, but the feature that tends to brand even fair mining finance as public exploitation is the sale of promoting shares as soon as issued; in other words, the failure to apply the deferment principle to realization. The inertia of public interest once set in motion is considerable and often permits the sale of promoting shares immediately after, if not with, those issued for working capital. Manifestly, by the immediate sale of their holdings at each flotation promoters stand to win though the mine should fail; hence there is no equality of risk.

The recognition of the essential soundness of the deferment principle is illustrated in many syndicate flotations where the prospectus calls for the return of the cash capital before dividends may be available for promoting or bonus shares. This does not overcome the iniquity of immediate realization of promoting shares, which, in the case of syndicate arrangements between financiers who also personally find working capital, is overcome by a pooling arrangement. Such a method does not, however, apply to public issues, and yet there is an insistent demand for some standard of sound finance touching the point. Only two attempts at a solution of the problem are known to me, one being the payment to promoters of their out-of-pocket expenses from the cash capital and the withholding of promoting shares until the cash shares have received at least 100% in dividends. A mealy-mouthed pose of virtue sometimes appears when it is stated that the promoting shares will not be sold until the market quotation of the cash capital shares have increased by, say, 25%. As most people have at least rudimentary ideas of the influences occasionally governing the market quotations, this bait will convey little beyond showing a paltry effort at throwing dust into the eyes of those seeking some sign of good faith. The second and most practicable, yet withal equitable, plan would seem to be that of allotting the promoting shares only when the present value of the ore reserve represents the total nominal capital (issued) of the company. Evidently the pressure on the engineer who values the ore reserve would be serious in some cases, and such a plan might be workable only if a definite method of valuation be accepted.

That this deferment idea is not merely an academic concept, having no expression in practical finance, is shown by the London Stock Exchange regulation that dealings in vendor and promoting shares are forbidden for six months after those representing the cash capital. Clearly this is a recognition of the lack of parity between the shares and is an effort to protect the *bona fide* investor, hence in the interest of mining adventure, as distinct from market gambling.

This consideration of promoting profits is usually avoided with painful pertinacity by engineers; yet it must be faced, not only when passing upon the real value of mining shares but when acting as negotiators in foreign countries. With that habit of making sweeping generalization or crude formulation, so common a defect of the scientifically educated, engineers are prone to take extreme views of promotion though a casual acquaintance will usually convince them of the special ability required and the number of cases where those promoting have stuck to a principle by refraining from taking tempting profits. While undoubtedly the great number of mining swindles accounts for the extreme difficulty of raising capital at times, even for the most promising venture, I hold that the mining engineer is responsible for fully one half of these fiascoes by reason of his inability to exercise a sense of economic proportion in valuation; also because of his lack of sound ideas touching finance, not to mention a haste to sell shares received in part-payment of fees. As in other lines of industry the hope of ultimately winning a social and civic position is the real deterrent to malpractice, so the most potent force tending to keep the engineer up to a high standard of effectiveness, moral and technical, is the opinion of the professional world.

It will be seen that the different kinds of shares usually issued are distinguished by their incorporation of one or both of the above principles, namely, varying risk-rates and times of deferment. For example, debentures by common consent and current practice imply provision for their amortization, necessarily a charge upon the known assets; they thereby incur less risk and receive a lower rate of interest. The debenture right of foreclosure in default of interest is also a recognition of the cumulative principle. Cumulative preference shares while ordinarily carrying no amortization privilege, not only aim to have this compensated by a higher annual return commensurate with the greater risk, but call for interest from the time of issue, even should dividends be deferred or suspended.

From the above is seen the recognition in financial practice of the equity, not only of ensuring a return of the capital when the risk-rate is low and the graduation of the latter to meet varying risks, but the incorporation of the deferment principle in cumulative shares.

We may then point out to reporting engineers that by failing to recognize the above two great principles when valuing reserves, we flout not only sound theory but current financial practice. Is it a wonder that intelligent financiers usually regard us as dreamers, incompetents, or charlatans when we, the supposedly scientifically educated, ignore the very elements of business knowledge? One may say that when engineers act as negotiators the practical application of the deferment

principle is the surest gauge of their business ability as expressed in the terms of the purchase price. For instance, where a single cash payment for a property exceeds the present value of the ore reserve, the excess is the price paid for possibility only ; in other words, is the sum risked. Without changing the ultimate purchase price but by simply deferring payment for a sufficient time in which to develop another level, the amount risked may be reduced to the cost of such development. The merest greengrocer before making a payment in purchase of a corner stall, will take it over for a time in which to verify his hopes of profit, yet no such simple business acumen seems to be expected of engineers. We may feel a thrill of righteous indignation with the man who classes granite with diorite, or a rhyolite as andesite, yet we mete out no censure to those who outrage the most elementary canons of common sense in the purchase of a mine.

The value of a debenture issue as a valuable adjunct to mining negotiation, whereby deferment of payments to several vendors may be secured, is seldom utilized though its basic element, the mortgage, is an instrument recognized in all countries. Where the interest on the mortgage is made equal to the dividends paid by a property productive at the time of purchase and the first amortization payment is so timed as to admit of adequate development before falling due, the original owners have nothing to lose in the way of dividends nor of property, yet they stand to gain by developments underground should the first mortgage payment fail. Evidently this use of a debenture issue in the place of cash for a property is of quite a different character from that ordinarily obtaining where money is raised for payment to vendors or for working capital under the assumption that there is no risk to capital or likelihood of loss of interest.

TABLE V.—DEBENTURE ANALYSIS.

1	2	3	4	5	6	7	8	9	10	11	12
End of year	Deferment in years	Debenture payments due per prospectus £	Factor from table of risk-rate 3%	Total income from estimated reserve £	Available after debenture charge £	Dividends on £1,100,000 £	Half balance of dividends for extra redemption of debentures £	Total payments on debenture and interest possible as per prospectus £	Present value at 6% £	Available for dividends on 1,100,000 ordinary shares £	Present value of amounts available for dividends with risk-rate at 3% £
1910	1	30,000	0·94340	260,000	230,000	230,000	—	30,000	28,000	230,000	217,000
1911	2	30,000	0·89000	483,000	403,000	202,000* & 110,000	6,000	30,000	27,000	312,000	278,000
1912	3	186,000	0·83962	270,000	140,000 & 6,000	146,000	0	186,000	156,000	146,000	131,000
1913	4	121,000	0·79209	270,000	149,000	149,000	0	121,000	96,000	149,000	118,000
1914	5	115,000	0·74726	22,000	0	0	0	22,000	16,400	0	0
TOTAL				1,305,000	928,000	837,000	6,000	389,000	323,000	837,000	744,000
								Paid for debentures	487,000	—	1,100,000
								Loss or difference	164,000	—	356,000

* All profits before June 1911 other than debenture interest to go to dividends; next £80,000 to debentures and £110,000, to dividends before further debenture amortization of £6000, which, with the £50,000, is payable at end of 1912.

Where mining debentures are accompanied by bonus shares, thereby making the former speculatively attractive, the tendency is to confuse the two principles of safety and speculation, and a careful analysis of the terms of the debenture issue is necessary to weigh the advantages peculiar to each.

The case of the Camp Bird issue made at the time of the purchase of the Santa Gertrudis property is an illuminating case from recent practice, as the above analysis in Table V. will show. It is based on published data only,

no private information being used. £500,000 of debentures were offered on the first of January 1910 at 97½ bearing 6% per annum and redeemable at 110; £150,000 for redemption purpose to be paid three years later; also £100,000 and interest on outstanding debentures to be paid each year following. Half of the profits made later than the middle of 1911, after paying 20% interest on a capital of £1,100,000, was to be set aside for further redemption of debentures. The dates of receipts and amounts of annual profits as per the estimates in the propectus are set out in the first and fifth columns of Table V.; columns 1, 2, and 3 give the dates of the proposed certain debenture payments, while column 8 gives the contingent redemption allowance. Column 9 sets out the total debenture payments and column 10 their present value up to the time of the exhaustion of the estimated ore reserve. A further consideration was offered the purchasers of the debentures in the shape of an option for three years on £250,000 of ordinary shares at 35s. per share. By an analysis of Table V. it is seen that the debenture subscribers are invited to lose £164,000 out of their £487,000, unless orebodies were found beyond those on which the engineers based their estimate, although their estimate for one mine of the two allowed for ore over 100 ft. below that of the deepest level, the other mine being acknowledged to be nearing exhaustion. In other words, the debenture-holders, instead of having the reserve set aside for their use and protection, were asked to risk £164,000, receiving therefor only 6% per annum during the same time. In the default of addition to the reserve they would lose nearly a quarter of their money, and even if more ore were found they could hope to receive for their risk only the stipulated 6% unless bonanzas sufficiently rich were struck to raise the price of the ordinary shares above 35s., thereby enabling them to make a profit, but only by the amount the shares might exceed that figure. Expressed otherwise, the ordinary shareholder might reap the benefit of the new orebodies, but so long as the profits made did not justify more than 35s. for the ordinary shares the debenture holders could expect only their 6% annually. In passing it may be added that the above issue of debentures has been called in, leading one to suppose that its defects have become evident upon closer scrutiny.

The next article will deal with the relative promise of company and syndicate flotations, a subject involving to a large extent the difference between investment and speculation. The latter is the very life of both science and industry. This, however, does not hold true of market gambling, a subject that though it concerns even the sound financier, is too complicated for the engineer, however versed he may be in the theoretical economics of finance.

The Chino Copper Mine.—New Mexico has not kept pace with Arizona in mineral production, despite abundant and varied resources. The new movement of capital into the southwest of the United States in search for copper, has begun to be felt even in the land of sleep, sunshine, and silence, where people are prone to live as their ancestors did before the troublesome 'gringoes' came into the country. The Chino mine is in a very old mining district, associated with the old name Santa Rita and many of the great names of American mining. Haggin and Hearst added to their fortunes here. The Confederate armies, short of lead, cast copper bullets from Chino ore, and Thomas Lawson, the irrepressible, drew from it inspiration for his most elaborate masterpiece of prose fiction. Copper was produced here when transportation was by mule to the City of Mexico, and in the midst of the modern works one of the towers of an old adobic fort erected as a defence against the Apaches, looks down on snorting steam-shovels and impatient, buzzing autos. The fort, by the way, serves now the prosaic purpose of a place where Mexicans and Indians having imbibed too freely of the white man's liquor, may cool off while waiting the slow revolution of the wheels of justice. The presence of old workings adds more than picturesqueness to the new undertaking. It made possible extensive sampling underground in advance of the steam-shovels, and the easy checking of churn-drill holes. The Chino, therefore, more than any other of the new copper mines, has confirmation of the results of its drilling. It is estimated that 45,238,231 tons of ore averaging 2·3% copper are available in this property, and that of this amount 71% may be mined by steam-shovel. The original source of the copper is not certain. Its present position is secondary. In one particular it differs from that at the other porphyry copper mines, namely, in the large amount of metallic copper present. This has made the sampling unusually difficult and has required special care in estimating. A concentrating plant has been built at Hurley, about ten miles from the mine where ample water and ground are available.

MINERAL RESOURCES OF CENTRAL AFRICA

By OWEN LETCHER.

ONLY within the past decade has Central Africa come to possess any measure of mining importance. The days when this vast tract of the world's surface between the Zambesi and the Nile was regarded as the particular domain of black men and wild beasts, bold explorers, and ambitious missionaries, are fast disappearing. A line of railway now stretches northward to Elizabethville in the Belgian Congo; another is hastening southward from Khartoum. Feeder lines branch east and west to pick up trade and carry products to the coast. The great lakes and rivers have modern steam-boats plying on them and give further help to the opening up of lands recently only associated with the names of Livingstone and Stanley. At this juncture, therefore, it may be of some interest to take stock of the mineral resources of the Great Interior as far as they are known, and briefly to discuss the potentialities of the mineral belts so far discovered.

The mining areas situated in the Katanga region of the Belgian Congo and controlled by the Tanganyika Concessions and the Compagnie Miniere de Haut Katanga loom large in the scope of this article. Few undertakings financed by British capital and engaged in the exploitation of minerals in a foreign country have received more searching and more deserved criticism. Vast sums of money are involved in the Katanga scheme of mine development and in the subsidiary projects of railway-building. One of the latter undertakings has achieved its objective at Elizabethville, 7 or 8 miles from the Star of the Congo mine. The other project, that of connecting Lobito Bay on the West Coast with the mineral belt, is proceeding but slowly. A brief consideration of the geographical position of the Katanga with regard to existing trade-routes and the ports of Europe and America makes it quite clear that Lobito Bay is the commercial key to Central Africa. But construction of the route from the West Coast (1200 miles distant) has proved a bigger proposition than was anticipated, and further large sums of money must be expended on the completion of the line and the proper equipment of the port itself before it can claim the trade of the interior. Completely to construct the line and equip the port, a sum of ten millions sterling is required. And when this project is consummated the Lobito Bay route will have to contend with serious competition from the Belgian as well as the British trade-routes. For the time being the British South Africa Company and the Port of Beira in Portuguese East Africa are reaping the benefit of the development of Katanga. Meanwhile Belgian financiers and the Government of the Congo State are making strenuous endeavours to divert trade to the navigable waters of the Congo river and so confine Katanga's imports and exports to Belgian territory. It will be interesting to watch the progress of the rate-war between these three competitive routes, assuming that the trade of Katanga is sufficiently large to make the contest noteworthy. That in the southern portion of the Congo State there are vast cupriferous deposits is not doubted, but that the properties of the Tanganyika Concessions and the associated Belgian corporations are about to dominate the copper trade of the world, as some have stated, is an anticipation apparently unwarranted.

The conditions in the Katanga are not paralleled elsewhere in copper mining. Many millions of tons of carbonate ore have been proved in the hills and kopjes that form the Katanga mineral belt, but the economic problem remains unsolved. In some cases the cupriferous beds may extend to considerable depth, though in the majority of the mines the beds are not likely to be found far down on account of folding of the strata. Owing to the great distance of the mines from the coast, the shipment of ore, even with the Lobito line completed, would be out of the question, especially as the smelter charges on such highly silicious ore would be high. The Tanganyika problem resolves itself then into the profitable smelting of the ore on the spot. At any time some new and epoch-making discovery in the metallurgy of copper may completely revolutionize the position, but it is unwise to depend upon the unexpected. The management of the Tanganyika Concessions for a long while has had the smelting problem under consideration, but its policy has not been disclosed, and it is rumoured now that the preliminary operations at the Lubambashi smelter, 12 miles from the Star of the Congo mine, have not resulted satisfactorily. It is known

too that a considerable divergence of opinion existed between an experienced American metallurgist, who was engaged to proceed to the Tanganyika Concessions, and the local management on the question of ore treatment; so much so that the American investigator severed his connection with the company. Blast-furnace smelting appears today to be the only really proved and reliable process suitable for the Tanganyika ores. In this connection much depends therefore on the cost of bringing coke to the Katanga smelter. Despite the statements that have been made from time to time as to the suitability of South African coal for coking purposes, it does not seem that anything satisfactory is obtainable in the sub-continent. The people controlling the Wankie colliery appear to be particularly silent and inactive in this connection, and it would be wholly premature to say anything regarding the possibilities of the Luano Valley coalfields in northwestern Rhodesia, southeast of Broken Hill, which are now being exploited by the Rhodesia-Katanga Junction Railway Co. The Tanganyika Concessions recently imported a large quantity of coke from Europe, the cost to the company when delivered at Katanga being something like £13 per ton. Looking at the problem broadly it would appear that on account of the large percentage of flux required by these ores and the heavy cost of the coke to be used in smelting them, the production of copper would be so expensive that high-grade ore only could be profitably handled. These facts, taken in conjunction with the vast sums of money necessary to complete the railway to the coast, and to construct branch lines to the several mines and the flux deposits, do not indicate that the Tanganyika Concessions will be producing any large quantity of copper ore within the next decade, and it is likely to be a considerable time before the production of Congo copper ore exerts any appreciable influence on the metal market.

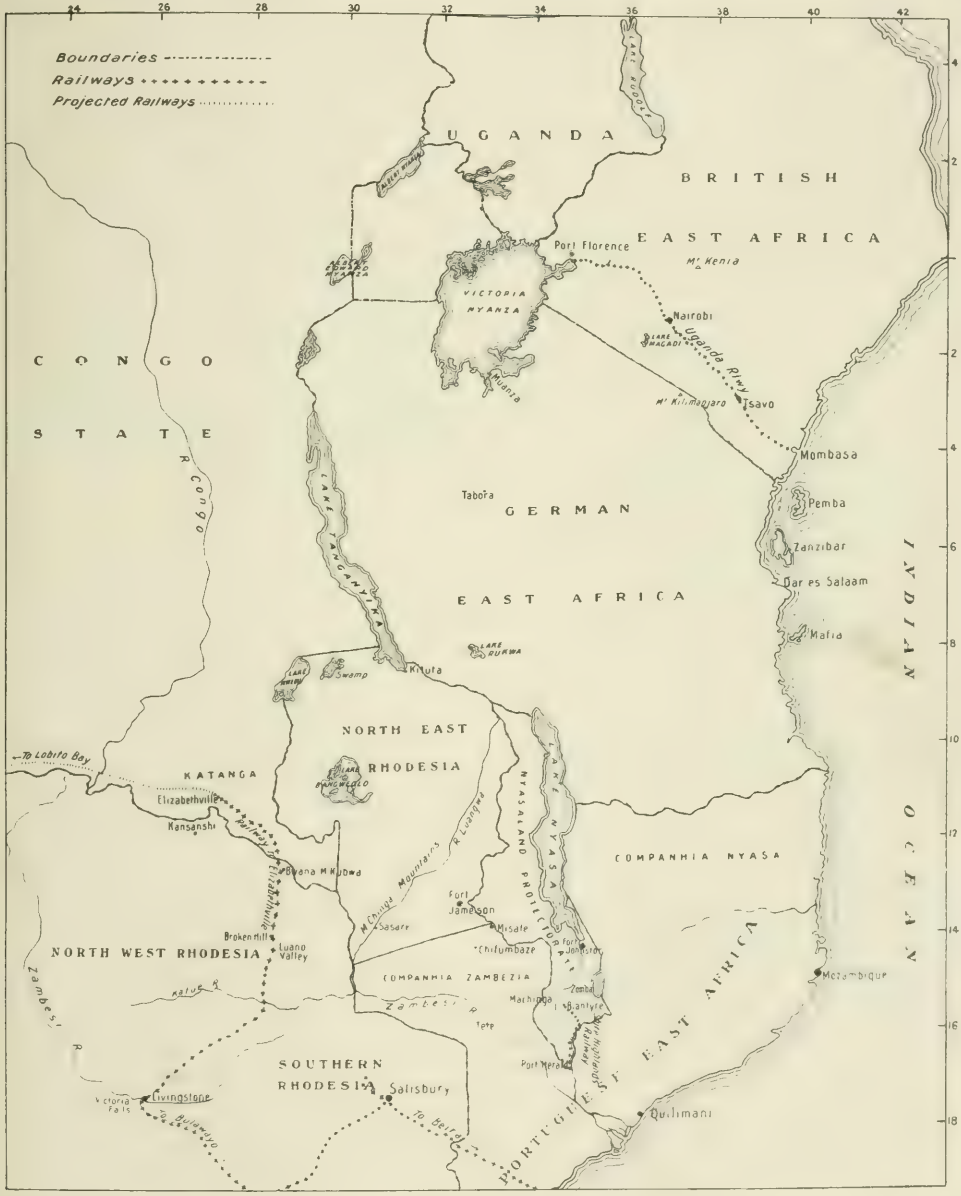
In addition to copper it is known that gold, tin, platinum, and diamonds have been found in the Southern Congo. The Ruwe goldfield, however, is now unproductive, and it is doubtful whether the remaining gravel is worth washing. This gravel results from the erosion of a bed of sandstone contained in the formation capping the escarpment on which the mine is situated. Several shafts have been sunk into the sandstone bed itself and it has been reported that the ground opened-up carries gold, platinum, and palladium, equivalent to about 11 dwt. of gold per ton, but considerable difficulty would be experienced in separating these metals. The latest flotation of the Tanganyika group is styled the Compagnie Miniere de Kindelungu with a capital of 2,500,000 f. The avowed object of this company is to exploit a concession in the vicinity of the Kindelungu mountains and which is said to yield diamonds. Cassiterite occurs in the Bussanga district but hitherto alluvial deposits only have been worked. Rumour has it that a discovery of cassiterite in a lode-formation has been made to the north of Bussanga, but as yet nothing definite is known.

The Congo State has rich mineral tracts other than those now being exploited in Katanga. In the mid-eastern portion of the territory and in close proximity to the Uganda frontier a rich gold deposit is being opened up near Kilo by a syndicate of Australian miners. The country is of a granitic and gneissoid character and is believed to possess considerable mineral possibilities. The district is not a healthy one and the transport of machinery and stores from Entebbe in Uganda, which is connected with the Mombasa-Port Florence railway, is an expensive and difficult matter. Some time ago the geologist of the East Africa and Uganda Protectorates reported on the area lying immediately east of the Congo State frontier, and it is quite likely that in the near future when lakes Albert and Albert Edward are linked with the Victoria Nyanza and the Uganda railway this area will attract much attention. Another and equally remote portion of the Congo territory where extensive mineral deposits have been discovered is in the Mweru and Bangweolo lake region. A group of Belgian financiers, styled the Thys-Jadot Syndicate, has acquired large concessions in this locality, and these have been found to contain copper-bearing areas similar in mineralization to those exploited in Katanga.

In northwestern Rhodesia there are several mineral-bearing areas north of the Kafue river. The most important and interesting of these are the lead-zinc deposits at Broken Hill, 375 miles north of the Victoria Falls, the Bwana M'Kubwa copper mine on the Congo-Rhodesian border, the Kansanshi copper mine of the Tanganyika Concessions to the northwest of Broken Hill, the copper mines situated in the hook of the Kafue River, and the coal measures of the Luano Valley to the southeast of Broken Hill.

Broken Hill, 2014 miles from Cape Town, was the immediate objective of the Cape-Congo railway after the bridging of the Zambesi at the Victoria Falls. There exist here

a number of hillocks or kopjes containing large amounts of mixed zinc and lead ores. The continuity of these deposits to a moderate depth has been proved by boring and it is estimated that some hundreds of thousands of tons of ore await immediate mining. The railway reached Broken Hill five years ago and small shipments of calamine were then despatched to Europe. The quantity of 'free' ore in the property, however, is small, and during the last three years small parcels of it have been sent to Europe for experimental purposes only. From the point of view of the mineralogist Broken Hill is of exceptional interest, containing as it does mixed ores of lead and zinc sulphides and sulphates, carbonates, silicates, and phosphates. Here are found the rare hydrated phosphates of zinc known as Tarbuttite and Hopeite. While the remarkable variety and association of the Broken



CENTRAL AFRICA.

Hill ores are of exceptional technical interest, these characteristics have proved far from satisfactory to shareholders. For long the solution of the metallurgical problems incidental to this venture have remained in abeyance. About the middle of last year the company was reconstructed and at the same time a subsidiary company was formed to deal with the complex ores. But a few months ago when I visited the property the mine was idle and from all that is to be gathered the new era predicted in the prospectus has not yet begun.

On the frontier of the Congo State and northwestern Rhodesia, the Northern Copper Co. possesses the Bwana M'Kubwa mine, famous for beautiful specimens of malachite. Engineers have reported that the quantity of ore exposed at 80,000 tons of 14% ore, and in addition a large quantity of lower grade stuff, yet apart from shaft-sinking little work is being undertaken at present. This mine is a subsidiary of the Rhodesia Copper Co., which in turn is an off-shoot of the Northern Copper Co. In this locality, too, is the Roan Antelope mine, a property of less importance.

In the hook of the Kafue river there are a number of copper properties under the control of the Kafue Copper Development Co., notably the Silver King, Sable Antelope, Rhino, and Hippo mines. These are situated some distance from the Kafue, and on account of transport difficulties and also because of the comparatively low grade of the ore, the mines have never come prominently before the public. At one time the construction of a branch line from the Kafue river station on the Beira & Mashonaland Northern Extensions Railway was considered, but the project has never materialized, and the prospects of its doing so are remote. As an alternative the utilization of some of the navigable stretches of the river combined with a porterage system along the banks, where rapids occur, has been suggested; this scheme also seems to have fallen out of favour.

The only other mine of importance in northwestern Rhodesia is the Kansanshi, in which the Tanganyika Concessions is largely interested. Given railway communication, this property might soon enter an important productive stage. As yet no such scheme appears to have been mooted and the property cannot at the present day be regarded as an asset of much value. A little gold has been found near Kasempa in banded ironstone, and toward the end of last year a company was formed to exploit this deposit. Northwest Rhodesia, unlike southern Rhodesia, appears to be singularly poor in the precious metals.

In the adjacent territory of northeastern Rhodesia, a vast and practically untravelled area which extends to Lake Tanganyika, an occurrence of gold in the Luangwa valley at Sassare has been worked for some years in a small way. The difficulty of transport in connection with this mine has proved enormous; it is indeed reported that it took a traction engine two years to reach the property from Tete. Add to this the disconcerting fact that sleeping sickness is sweeping down the valley, and it will be apparent that Sassare is not a venture of any great promise. Gold occurs here in basement schists which are correlated with the Swaziland schists of the Transvaal.

About 160 miles north of the Zambesi, in Portuguese Northern Zambesia, some activity has been displayed of recent years at Chifumbaze, and 25 miles farther north, at Missale, on the borders of northeastern Rhodesia, Nyasaland, and Portuguese Zambesia, a little work has been proceeding on an auriferous quartz lode known as the Chabuino. At Chifumbaze a German company has erected, on the Maggie's Luck mine, a 10-stamp battery and has been working some gold-bearing quartz leaders in a granitic matrix, but the results to date do not indicate a profitable operation. Four miles from the Chifumbaze administrative post there is another gold-bearing proposition known as Muende where encouraging assays have been obtained in a well defined highly pyritic lode, which has been opened up for at least a mile along the surface and by means of several shafts. The lode is excessively hard and this has militated greatly against development work. Chifumbaze is evidently the centre of a mining area of great antiquity. On many of the granite boulders scattered along the flanks of the mountain ranges, inscriptions and paintings which are considered by authorities to date from a remote past have been found, and there are also extensive ancient workings in the vicinity. The Chabuino mine at Missale is owned by a Chinde syndicate and attempts are now being made to float a company with a substantial working capital. Another mine situated about 80 miles north of Tete is the Machinga, where a medium-grade quartz proposition is being developed. A five stamp-battery has recently been erected here after well nigh insuperable transport difficulties had been overcome.

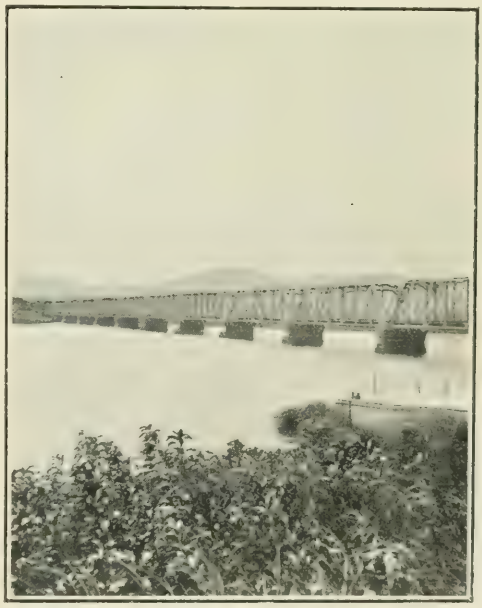
Coal has been found in restricted areas

along the Zambesi. Little attention has been paid to the development of this asset as yet and the river-steamers all consume wood as fuel. This deforestation is undoubtedly exerting a bad influence on the rainfall. Copper has also been discovered and graphite occurs in Portuguese Angonia. Gold is found

The mineralized kopje of the Rhodesia Broken Hill.

in Nyasaland near Fort Johnston and at a number of other places ; it is distributed over a large area of the British Central African Protectorate, but apparently in unprofitable proportion. Graphite is being opened up in the Angoniland or midwestern part of the Protectorate ; it is reported to be of high-grade quality and an interest has been acquired in the deposit by Lewis & Marks, the South African financiers. Mica occurs in Nyasaland and is of a most promising quality. It is found notably near Fort Johnston at the southern end of Lake Nyasa, from which place considerable quantities have already been exported. The mica industry bids fair to become an important commercial factor in the future development of Nyasaland. This, however, is a colony that can never take prominent rank among the important commercial dominions of Africa until the southern end of the lake—the trade centre of the country—is in direct railway communication with the coast. The Shiré Highlands Railway is an unfinished transport enterprise that extends from Blantyre to Port Herald, a distance of 114 miles. Transport in the Nyasaland Protectorate has in the past depended largely on the Shiré river, which flows out of Lake Nyasa and enters the Zambesi near Villa Bocage in Portuguese East Africa. It is a well known geographical fact that of recent years the level of the waters in Nyasa has been declining and consequently the Shiré before the rains have fallen has proved an unsatisfactory water-way. Hence the trade of the Protectorate has been greatly hampered, and it is recognized that no real assurance with regard to transport will be possible until the lake and the Indian Ocean are linked by a dependable means of communication. Between the coast of Portuguese East Africa and Lake Nyasa there are indications of mineral wealth. One or two expeditions have of recent years penetrated into this hinterland, which is unhealthy, little known, and peopled by natives who are not well disposed toward Europeans. One expedition was despatched by the Rhodesia Exploration & Development Co. during the last dry season to Ribawe and the Bwa Bwa river, but the results secured were of an inconclusive nature. One or two of the members of the expedition died, and the mission generally was a failure.

In German East Africa, gold has been dis-



Bridge over the Kafue.

covered in several localities, notably in the vicinity of Mwanza, a port on the southern end of the Victoria Nyanza. The precious metal occurs here in granite and recently some high assays have been reported. It is understood that a company is about to be formed in London to exploit the Mwanza gold mining area, which is now being examined for a report.

British East Africa it apparently a colony of little or no mineral possibilities apart from

soda. The recently floated Magadi Soda Co. has a scheme of a highly ambitious nature under consideration in connection with the famous Magadi deposit, a scheme that includes the construction of a branch line from the lake to the trunk system of the Uganda Railway and the improvement of loading arrangements at Kilindini, the port of the country. The deposit of the Magadi lake is a notable occurrence, fresh soda crystals being continually formed. Having regard to the strong and influential auspices under which the project has been launched it appears highly probable that the export of soda will become one of the principal industries of a colony which hitherto has seemed to be best fitted for the stock farmer, the rubber planter, and the big-game hunter.

A little copper, in the form of malachite, has been found in the Protectorate near Tsavo (renowned for lions) and indications of coal have been discovered at several points, but generally speaking the East African Protectorate is not a region that offers attractions to the financier or the engineer.

The further development of the various mineral deposits of Central Africa is obviously dependent upon the general policy of the controlling powers with regard to railways. There are many mineral fields where the advent of a cheaper and more efficient means of transport would stimulate the areas in question into production, whereas today the great bulk of these are of potential importance only. Equally vital are questions relative to native labour and the scientific conquest of tropical diseases, such as malarial fever, blackwater fever, and sleeping sickness. The onward march of civilization and the increasing demands of the modern world for metals and profitable fields for the investment of capital will in the fulness of time make Central Africa, like South Africa, a vast and productive mineral field. These developments cannot progress at any noteworthy rate at present; and it may safely be assumed that many years will elapse before the mineral deposits of the heart of the Last Continent will attract anything like the attention that has been accorded to the Southern and Western regions.

Oil in Mexico.—The West Coast Oil Co., in which English capital is largely concerned, and which hopes to develop extensive oil supplies in the West of Mexico, has commenced drilling in Northern Sonora. The scene of operations is near Mascareñas.

Transvaal Diamonds.—Official returns have been issued of the production of diamonds in the Transvaal for the first half of 1911. In giving the figures we would make the prefatory reminder that the chief producer in the Transvaal is the Premier mine; and that the other great producers, the De Beers and the Jagersfontein, are in the Cape Colony and Orange Free State respectively. The number of loads washed during the half-year was 4,107,733, the yield 852,719 carats, and the value £659,968, as compared with 4,362,107 loads, 942,289 carats, and £607,024 during the second half of 1910. It will be seen, therefore, that though the output was smaller, the prices received by producers from the selling syndicate have advanced. The following table gives figures relating to the output during the last 10 statistical years commencing with July:

Year	Carats	Value £
1902–3	33,572	46,358
1903–4	497,917	625,720
1904–5	995,002	1,198,530
1905–6	758,406	968,229
1906–7	1,545,336	2,203,511
1907–8	2,184,490	1,879,551
1908–9	1,929,491	1,295,296
1909–10	2,098,528	1,317,479
1910–11	1,795,008	1,266,992

Coal in Ireland.—A scheme is on foot to work the coalfield in Kilkenny and Queen's counties in the southeast of Ireland. Parliamentary powers have been obtained for the purpose of constructing a railway line from Athy to Kilkenny, that will pass through the district. For some time the deposit has been worked on a small scale, about 40 tons being raised per day. It is intended to increase the output to 400 tons per day when railway communication is secured. The promoters assert that 100 million tons of steam coal are assured, but there are good reasons for doubting their claim both as regards extent and quality. As in many other ways, Ireland has been unlucky in respect of her coal measures. The central part of the country is a vast plain with mountain limestone as the basal rock and covered with drift and peat. At one time the limestone was covered with coal measures, but nearly the whole has been swept away, leaving only a few isolated patches here and there, that mentioned and one near the junction of Cork, Limerick, and Kerry counties being the largest. There are also smaller patches farther north in Meath, Tyrone, and Leitrim.

DISCUSSION

Our readers are invited to criticise anything appearing in this magazine and to discuss other subjects of general technical interest.

Percentage of Recovery.

The Editor:

Sir—Mr. C. W. Wright, in the July number of your magazine, gives a valuable addition to the mathematics of the calculation of percentage of recovery. When my first suggestion was published some months ago I was under the impression the idea was new, but since then I have been made aware that several dozen engineers "knew all about it a long time ago." There was, however, one publication—of which I was entirely unaware at the time I wrote my article—that I should mention: Dr. Rudolf Gahl, in the April 1909 number of the *Western Chemist and Metallurgist*, published a most excellent article on the calculations of percentages of recovery, in which article he completely anticipates all my ideas, and sets forth in a very able manner several other valuable formulas for the use of engineers. Though perhaps unkind to say it I feel it nevertheless is true that the reason of the oversight was that Dr. Gahl's article was published in a paper of so little circulation that the average engineer had no chance of seeing it. Had Dr. Gahl published his article elsewhere than in a 'backwoods' magazine I would not have "infringed" his "invention."

THEODORE J. HOOVER.

London, July 14.

Values.

The Editor:

Sir—In an editorial in your April number I read with interest your criticism of the use of the word 'value' in mine reports, and although an enthusiastic supporter of your campaign against illiterate reports and loosely worded technical articles, I venture to think that you have been hyper-critical, if not in error, in your complaint of Mr. H. A. Piper's use of the term in question.

It would seem from your article that you consider 'value' only refers to £. s. d., but surely the value of many things is not measured by money; for instance, the value of x and y in a quadratic equation is not always found in pounds sterling. Mr. Piper's use of the term is merely a contraction of assay-value, and the measure of an assay-value is expressed in dwt. or percentage; but even supposing 'value' is not a contraction of assay-value, I disagree that unprofitable ore should be called 'valueless.'

Would you, Mr. Editor, in reporting that the s.s. *Unfortunate* had foundered in mid-Atlantic with specie on board, state: There is a 'certain amount' of gold of no value at the bottom of the Atlantic"? Would you not prefer to write: "There is gold to the value of £1,000,000 at the bottom of the ocean, but we fear that its recovery will be an unprofitable enterprise."

There are doubtless methods and processes of the future that will turn mines at present unprofitable into profitable concerns, but obviously there is nothing except the philosopher's stone that will turn valueless quartz into valuable gold. I suppose all engineers agree that the net profit on ore developed is the most important point of a mine report, but why deprive interested shareholders of information concerning the 'values' of an unpromising block of ground.

WILLIAM R. RUMBOLD.

Northern Nigeria, June 3.

[Mr. Rumbold's protest is welcome, even if we cannot accept his view of the case. Undoubtedly we are in danger, like other enthusiastic reformers, of being hyper-critical at times. Is it not true, however, that 'value' as used in commercial affairs, especially in connection with the exploitation of mineral resources, does refer to measure in units of money? The miner does not look at his ore with the eye of a philosopher, otherwise indeed he might read into 'value' a hundred meanings of a most allusive kind. For instance, the value of a discovery of gold ore in a new region is not only its gift of wealth to an individual prospector but the spread of modern civilization into a new corner of the earth. Even a find unprofitable in terms of money may prove of the utmost beneficence by stimulating exploration and inducing immigration in a country capable of development in branches of industry other than mining. In regard to the use of 'value' as a synonym for 'assay-value,' we have already, in the leader criticized, drawn attention to the confusion likely to arise, shareholders and the public generally assuming that it means 'profit.' The 'assay-value' of an ore is its gross value, according to the market price of the metals contained, but its 'value' is the gross value less the total cost of extraction, in other words, the net return to the proprietors. An ore containing 1·9 dwt. gold, with traces of copper, in Rhodesia may be said to afford indications useful to a prospector but it cannot be described as having any commercial value in the year 1911. Possibly in 2011, or even sooner, such ore will become a source of

wealth to the enterprising operator. In the meantime we try to give precision to words by limiting their meaning so that, for example, an ore is said to have value when it yields a profit in this day and generation, not *post paulo futurum*. The ocean contains gold values in the Pickwickian sense of Messrs. Piper and Rumbold, but it has no value just now as a gold mine. In the Greek Kalends we may find it more profitable to work at sea than on land, but not in the palpitating present. Those who find that they can express themselves explicitly by using 'value' and 'values' will continue to do so, but we hope that they will reconsider the matter anew.—EDITOR.]

Official Valuation of Shares.

The Editor:

Sir—From your columns I gather that you and many of your contributors regard precious metal mining as a legitimate business and that you consider mining engineers as honoured members of society. My own observations are at variance with these conclusions, for I find that precious metal mining is regarded by many financiers as less dignified than horse-racing, and that mining engineers are given a lower social rating than horse-trainers.

The management of the precious-metal mines is largely entrusted to graduates from technical schools; these, when beginning the practice of their profession, are men of high ideals. Hence, it would seem to follow that precious-metal mining should be honestly conducted, and that mining shares should be regarded with favour by conservative financiers. But the actual state of the case is that the purchaser of mining shares is regarded as a gambler and the industry is thereby discredited. To a high-minded engineer the odium wrongly attached to the business is galling. That it is galling is shown by the active manner in which mining finance is being discussed in the technical Press, notably in your columns.

I do not consider that this disrepute need be permanent and I propose to point out a powerful means of bringing mining into better repute. My proposal is that shareholders in all precious-metal mines be furnished with an official valuation of their shares at least once a year, or oftener, if necessary.

Mr. M. H. Burnham (in your issue of July) has recently studied this question and has suggested that fuller information be furnished to the shareholders of mining companies. His suggestion is admirable, but it does not go far enough. Even if the information he asks is given, the position of the ordinary buyer of mining shares is but little improved, for it is impossible for the ordinary mind properly to interpret the mass of statistics included in a complete mining report. The prospective buyer or shareholder asks: "What are the shares worth?" Every annual report should answer this question explicitly. The filling up of the following form would give all the essentials:

A fair valuation of the shares of the Hypothetical Mining Company on June 30, 1911, is:

Preference shares.....£——
Ordinary shares.....£——

This value is deduced from:

Present value of the plant....£——
Value of ore developed.....£——
Value of probable ore.....£——
Value of other assets.....£——
Total value of property.....£——
Number of preference shares..£——
Number of ordinary shares...£——
Value per share.....£——

This valuation should be made by the manager of the company, and a full explanation should be given as to how it is obtained. In other words, instead of having a hodge-podge of statistics, which not one man in fifty can interpret correctly, I would give the shareholder the final opinion of the management as to the value of his shares.

I do not contend that this valuation will be absolutely accurate, but it will be definite and will represent the best judgment of experts most familiar with the property. The chief merit of the valuation is that it tends toward openness and straightforwardness; it works against crookedness and concealment. When generally adopted it will be a great safeguard against the wiles of the predatory promoter, both for the engineer and the public.

It does not follow that the market-price of the shares will be identical with the valuation, but there will certainly be a close connection between the two; and the official valuation will surely tend to prevent such sensational collapses as have been lately seen in Waihi, Golden Horse-Shoe, and (Editor, please mention some instances of sudden falls in market-price). [It is not necessary, each reader can do so for himself.—EDITOR.]

I feel quite certain that if a system of managerial valuation of mining shares is put into practice it will greatly benefit all honestly managed mining companies; and all persons interested will wonder why business was done without it.

Possibly some of your readers may cavil at my calling the buying of precious-metal mining shares "gambling" and may retort by remarking that "Everything is a gamble." In the misty domain of metaphysics this dictum may be true, but in the actual world of finance it is easy enough to draw a sharp distinction between investing and gambling.

A concrete instance may make my statement plainer: Suppose the case of a young heir who has just received his fortune and finds that it is—with mistaken wisdom—invested in British trustee stocks bringing 3½% income. If our young friend wishes to increase his income and consults a financier regularly engaged in the prudent investment of funds, say, the manager of the securities department of one of the London joint-stock banks, and says to him: "I am thinking of selling out my trustee securities and buying some better-paying bonds such as Chilian Govt. 5%; Rio de Janeiro Trams First Mortgage; Antofagasta & Bolivia Railway bonds; Southern Pacific convertible 4's.," nearly every conservative financier in London will say: "I think on the whole that you are making a good investment." But if the same young heir were to say: "I propose to sell my trustee stocks and put the money in the following gold-mines." (Let the reader fill out the list to his own satisfaction). The equally certain reply would be: "I cannot advise you to make the change; you had better stick to the securities that you have and not begin gambling."

Humanly speaking, the capital invested in the sound securities will be intact ten years hence, while a large portion of the money used in buying mining shares will be lost. On the other hand, there is no likelihood of the sound securities advancing greatly in price while there are great chances of gain from the advance in price of the mining shares.

Everyone familiar with the subject can recall mining shares that have doubled or trebled in price within a year, and greater gains are not uncommon, for instance: the shares of the Mohawk mine in Nevada advanced from 20 cents to $20 within a year. Equally familiar are the sudden collapses in the price of mining shares: witness the recent tumble in the price of Waihi. Thus the buying of precious-metal mining shares brings prizes and blanks, and dealing in them is practically a lottery.

The gambling spirit is inherent in human nature and men will always pay more for a gambling chance than its strict mathematical value as calculated by the theory of probabilities: consequently the market-price of mining shares, as a whole, will always exceed their real value. Thus, from my point of view, the case of the buyer of mining shares is always desperate, and to handicap him further by incomplete and misleading reports is an outrage. He should be put in possession of all the essential facts relating to the company in which he has an interest and the final deduction from these facts—that is, the valuation of the shares—should be made for him by his servants, the directors and manager of the company, who alone have all the data. And it is because I want shareholders to be fairly treated, and to be in a position to act intelligently, that I advocate this managerial valuation of mining shares in the annual reports of companies.

The giving of detailed information as to ore reserves, costs, and other factors controlling the values of the shares is becoming more common; some of the best reports furnish almost all of the information needed, but even these exceptional reports would be greatly enhanced in utility if they contained a direct valuation of the shares.

Such full reports are, however, in a minority; the great majority of mining reports do not give enough information to allow of a correct valuation; or, if the information is contained in the report, it is given in a confused manner and thus rendered practically useless. To show more plainly what I mean I select at random the last report I have received—that of the Prestea Block A—for the year ending December 31, 1910. This report is unusually and commendably full, and is particularly complete because it contains a map of the ore reserves. But the report contains no valuation of the shares and does not give enough information to enable a reader to value them. I notice that, in an editorial in your July issue, you attempt to value these shares and, with all due deference to your special knowledge of mining costs and accounts, I think your valuation is incorrect. And, certainly, if you, with your great experience are led into error an ordinary shareholder would be utterly unable to approximate the value. Your error in the estimate of the value of these shares arises from an assumption that the market-value of the property is £1,275,000 at the time it will be paying £250,000 annually. This market value is based on 850,000 shares at 30s. per share, the present quotation, but it is stated in the report that at least £200,000 more capital will be required to complete the plant; therefore at the time the

mine is earning the £250,000 annually—if there is no decline in the market price—the total capital will be at least £1,500,000 and the profit earned will be only 16⅔%, instead of the 20% you make it. However, I am not at all interested in getting at the exact valuation of these shares, but am only interested in pointing out the deficiencies in the report. And whether you are right or not on this point is not of any importance; the discrepancy between your ideas and mine only shows how essential it is that the calculations as to the value of the shares should be carried out by the manager of the company, who alone is fully conversant with all the data required for a trustworthy appraisal.

In the case of the Prestea the most clever engineer would find it impossible to value the shares by means of the annual report, for no estimate of the probable extraction or of the probable working cost is explicitly given. I do not think it worth while to go further into this matter, and will only say that the Prestea report is a great improvement on most of the mining reports that I read.

There is no reason why this valuation of shares should be confined to mining companies, and I believe it would be a valuable feature of all annual company-reports without reference to the business engaged in. I recommend the subject to your readers for discussion and suggest that the Institution of Mining & Metallurgy might well insist that its standard annual mining report should contain a managerial valuation of the shares.

SPECULATOR.

London, August 20.

Prospecting in the North.

The Editor:

Sir—I have read Mr. Winchell's letter in your May issue, in which he disavows any intention, in his article on 'Prospecting in the North,' of hitting at Canada—he wasn't thinking of her at all. I cheerfully accept this disclaimer. If he had gone further and said there were other things he had overlooked, I should still have accepted it. I merely mentioned Canada to account for my temerity in openly questioning the conclusions of a recognized authority on ore deposits.

Respecting his exception to my use of the term 'hydrosphere,' it of course is not a synonym for the zones of rock decay and secondary enrichment, but the relationship that exists between these and the zone in which surface water "permeates the pores and fissures of the outer part of the solid earth" or "exists as such in the interstices of the lithosphere" seemed to me so obvious that, lacking a strictly applicable technical term, I concluded to imitate the great writers and indulge for a moment in metonymy. Of course the proper procedure in technical literature, when one cannot recall a precise technical term, would be to invent a new one. I might have called the zones of rock decay and secondary enrichment the 'minersphere.' It would naturally be limited to the Temperate zone, the Boreal or Arctic zone constituting merely the 'prospectorsphere.' But that wouldn't have settled all differences, for Mr. Winchell would still have insisted that the Temperate zone did not extend into the glaciated belt, while I should have quoted dictionaries and elementary physical geographies to prove that properly and actually it embraces most of the glaciated belt, and, in places, districts quite beyond the northern edge of this belt.

He considers a reference to dikes irrelevant. But it was introduced in opposition to his statement that in the rocks in the glaciated zone "fissures and crevasses are rare"; where recent dikes are so numerous, fissures cannot have been rare.

Mr. Winchell in his article described a limited district in some detail, a district just emerging from glacial conditions, many of which still obtain. A considerable part is still under ice. The exposed glaciated rocks have just come into contact with the air. Erosion under these conditions is excessive, decomposition relatively slight. He states that the description "holds good for a large portion of the globe in northern latitudes." With this I cannot agree. It holds good only for those areas that still carry glaciers, or from which they have just disappeared. Elsewhere decomposition is relatively important and erosion relatively slight. Consequently, "if we contrast the situation just described with the conditions farther south" and "at once begin to appreciate a few of the reasons why so large a proportion of our rich mines are found south of the border of the former glacial mantle," I think we shall be liable to be found in error. One who takes this appreciative position surely is assuming that in the glaciated belt glacial conditions have always existed. If they haven't, rock decay and secondary enrichment have taken place. In the Klondyke, which, we shall both agree, is somewhat boreal, the gold-bearing White Channel gravels are so decomposed that even magnetite is scarcely to be found, and nothing remains

but quartz and sericite. It is difficult anywhere to find more striking examples of rock decay than in this boreal region. If rock decay has been important in pre-glacial times, which is shown to be the case in the Klondyke, then glaciation, which has removed, except locally, little but the decomposed surface of the rock, must have left, except locally, the enriched sulphide zones of veins. That the glacier cannot have removed much of the 'live' rock is proved by calculations of the amount of glacial drift, obtained from the glaciated belt. But it is unnecessary to build up an argument to show that the enriched sulphide zones must, in many cases at least, remain. One can go to the mines to see them; there they are.

I do not see the grounds for his implication that those in glaciated districts fail to realize the importance of secondary enrichment. As a matter of fact it was recognized here before the papers of Emmons, Weed, and others, on the subject, filtered into darkest Canada. I did not minimize its importance; my argument was simply that even if it were admitted, which I certainly did not admit, that no secondary enrichment was to be found in the glaciated belt, in the face of the discoveries in the prospected fringe of this belt, one was scarcely justified in a sweeping generalization that rich mines were rare. He does not allow secondary enrichment the importance I should like, or was contending for.

This explanation may account for my mentioning classes of deposits which he expressly excluded; though why, in the light of the views of the Lake Superior geologists concerning the origin of the iron deposits he should so exclude them or why loose superficial gold placers should prove too hard a nut for a glacier that was sweeping off the entire enriched sulphide zone, is not obvious. It will not do to say that gold placers do not require decomposition for their formation, for in regions of dominant erosion they are relatively rarer than rich lodes, and the richness of a placer seems to bear quite as intimate a relation to the extent of decomposition as does that of a vein.

I confess to a degree of prejudice in favour of the country I know best. I doubt if my friend, Mr. Winchell, is wholly free from the same weakness; nor is the prospector who turns down the new camp because he fails to recognize in it the limestone that, in his old stamping ground, he learned to love.

R. W. Brock.

Ottawa, August 11.

Critical Moisture in Tube-Mill Feed.

The Editor:

Sir—Replying to Mr. W. R. Dowling's letter of May 15, I am obliged to him for pointing out that there is much more water present in a 40% pulp than is required to fill the voids, and consequently for correcting any misapprehension in this regard.

Evidently Mr. Dowling has little faith in the existence of a critical moisture, since he asks us to believe that with feeds of under 200 tons per day, a 27% pulp is more efficient than a more diluted pulp. On the other hand, Mr. Neal offers satisfactory data for believing that with a feed of 125 tons per day, which is well under Mr. Dowling's maximum figure, a 39% pulp is most favourable for maximum grinding, and Mr. Ball's experiments point also to the existence of a critical moisture almost identical with Mr. Neal's.

If there is a critical moisture there ought to be a reason for it and my letter was written in the hope that additional information would be forthcoming. Under the circumstances, I think we may fairly ask Mr. Dowling to offer as satisfactory a series of experiments in support of his statement about a 27% pulp as Mr. Neal offers in support of a 39% pulp. I must frankly admit, in the light of Mr. Dowling's remarks, that the explanation of a critical moisture presents difficulties and that more data will be required to reach a satisfactory conclusion. Possibly the specific gravity (buoyancy) of the material to be ground is a factor which deserves more consideration.

John W. Bell.

Montreal, July 15.

The Editor:

Sir—I have read with much interest the letters in the April and June numbers of your magazine by Messrs. J. W. Bell and W. R. Dowling on the subject of tube-mill feeds. Part of Mr. Bell's letter was unintelligible to me, owing to a slip that has already been pointed out by Mr. Dowling, but I was pleased to see him open the discussion of a subject which presents so many points of interest.

Although the article supplied to the *Mining and Scientific Press* by Mr. W. Neal, to which Mr. Bell refers, embodied the results of some research work done by me in March 1909, I have never supposed that they established a rule applicable to all varieties of tube-mill feeds, since the variation in tonnage and coarseness of sand fed during the series of experiments was comparatively slight. I am inclined to think that a few very simple rules

govern the variation in efficiency of a tube-mill indicated by tests such as those referred to. The thickest discharge that I have been able to obtain from a cone fitted with a suitable diaphragm contained 28% moisture. Now, battery-sand containing 28% moisture is perfectly fluid, and will run quite easily down a 25% grade; but slime, 80% of which will pass a 200 mesh, containing 28 or 30% moisture, is 'cake,' as no one will need to be reminded who relies on this property for the satisfactory operation of leaf-filters.

One cannot feed a 22 or 24-ft. tube-mill with about 70 or 80 tons of sand per day at 30% moisture without producing a discharge which is noticeably viscous, the loss in fluidity being indicated by a rapid rise in the power necessary to drive the mill. If the feed is increased to 200 or more tons per day (I am speaking of tough quartz), the discharge of the mill is still quite fluid at 34% or 35% moisture, and it becomes advantageous to increase the time of passage of the pulp through the mill by reducing the dilution to a point depending on other circumstances.

At present, my experience suggests that, within wide limits, the best results should be obtained by keeping constant the quantity of liquid added, so that the dilution falls and rises as the tonnage rises and falls. One limit is supplied by the mill in which the tonnage has been reduced until the percentage of moisture has risen above 40%, and the other is suggested by the state of the mill referred to by Mr. Dowling, which could not crush 400 tons per day at a low dilution, as the stream of fluid was not sufficiently strong to wash out the fine sand accumulated in the mill. The latter is a condition of which I have no experience. I have intended for some time to investigate this question further, and shall look forward to the publication of the results of the series of experiments referred to by Mr. Bell. If these are not already concluded, I would suggest that the results be reduced on a basis that shall assign "metallurgical value" to different pulps according to the area of surface exposed. It seems to me that the calculation of relative mechanical efficiencies from tables of 'Mechanical Equivalents' brings the fine-grinding machines, such as the tube-mill, into a discredit that is not entirely merited. Granting that any system one may adopt for the calculation of the mechanical values of pulps will show a rapidly decreasing mechanical efficiency as the material treated becomes finer, I wish, nevertheless, to deprecate the habit of considering a metallurgical device as though it were a power-station. The series of mechanical equivalents calculated by Mr. Stadler tempts one to its use, as there seems only small scope for error in the value it assigns to the finest sizes "including washed slime." If, however, we tabulate, side by side with Mr. Stadler's equivalents, the relative area of surface exposed per unit of weight, we find an enormous increase in the value to be given to the very sizes in which the rise of mechanical value has become so slow. This has been sufficient to convince me of the futile nature of Mr. Stadler's method of comparison.

Although we are not yet able to make sizing-tests on pulp finer than 200-mesh, there are many ores in the world whose successful treatment depends on the presence of a proportion of 300, 400, or even 1000-mesh material in the pulp as treated. Any grinding machine that produces such material in large quantities will be given credit for it in any fair method of comparing efficiencies.

It would be interesting to know what form of diaphragm Mr. Bell has found to give the steadiest discharge, for feeding to tube-mills. Convinced that the function of the diaphragm was merely that of a mixer, I abandoned the type of plate developed by Mr. Caldecott some time ago and now use a round plate with holes drilled in it each slightly smaller than the size of the discharge to be used. For instance, for a 6-ft. cone, I use a plate of 14-in. diameter, with 12 holes each $1\frac{1}{4}$ in. diam. Eight inches above this comes a solid plate rivetted to angle-irons, so as to leave an annular space of $1\frac{1}{2}$ in. With such a cone, it is quite easy to get a thick and perfectly steady discharge, and yet keep the bed of sand about a foot below the top of the cone, thereby improving the classification effected.

A. QUARTANO.

El Oro, Mexico, July 28.

Mine Salting.

The Editor:

Sir—A few supplementary remarks might be added to Mr. T. Lane Carter's article in your June issue. The list of salting tricks may be amplified, thus:

The interested person having the 'salt' on the top of his hat-brim, and allowing it to fall in the sample as he casually inspects the work; having pieces of the rich ore inside his trousers band, and slipping these into the reduced sample; having the 'salt' in a hollow lead pencil, or pencil-holder, or within a cavity near the bottom of his walking-stick; in cigarette, pipe,

or chewing tobacco. Or, being curious as to how it is all being done and showing an intelligent interest in the various steps, the guileless owner may try to poke around in the sample with his 'sore finger,' around which a rag is tied, or under the finger-nail of which the 'salt' reposes. An acquaintance once told me how he had caught-on to an attempted 'sweetening' during a placer inspection. He noticed in each pan washed for him by the guiding and obliging owner the same shaped little nugget. It took some time to find out that his guide and mentor, who was an exceptionally expert panner, was catching the gold after each panning and holding it there while the pan was being filled with fresh dirt. Of course this would have had no bearing in a formal examination, but it might have caused the starting of a useless and expensive investigation.

The plain moral of the foregoing is to keep all outsiders away from the work, especially during the reduction of the samples, but this is not always as easy as it sounds, particularly when on preliminary inspections and when among natives having no conception of the ethics of the case. Ethics or no ethics, however, the diplomatic engineer will compass their absence when occasion demands it.

Emphasis might be laid on some of the precautionary measures mentioned by Mr. Carter, such as panning, the taking of dummy and of duplicate samples, the making up of 'composite' samples; and, particularly, the cleaning of the faces prior to taking the sample; even going to the extent of moiling preliminary cuts when thought expedient. (A whisk broom ought to be a part of every sampler's kit.) And if a description is written of each face sampled, and a note made of its probable assay, the engineer will find it of assistance, in detecting any 'monkeying,' and in other ways.

Constant watchfulness is demanded over the whole work, but especially over the finished samples. After these are down to pulp-size extra precaution should be taken against the well advertised hypodermic. I recall hearing of an engineer, who after the mine had failed to hold up to his sampling, discovered a needle-hole in the bottom edges of his sample-envelopes. And I suppose everyone has heard of the exchanging of samples by means of ripping and re-sewing of their receptacles. I find it convenient to have a large box in which the bagged samples can be locked during the pulping operations, or until I am ready to 'pull out.' Such a box can usually be found around the plant (tool-boxes, etc.), or else quickly knocked together out of rough lumber. All chinks and cracks should be stopped, from the inside, and the whole inside so marked and sealed that no portion can be moved without it being detected. This box can be sealed also on the outside by a thin inconspicuous thread, or piece of horse-hair, and more ostentatiously by the engineer's private wax-seal and peculiar string. It is safest to also seal all windows, screens, and doors of the assay-office, or wherever the samples and flux are stored. A trunk or two would serve the same purpose as the box; but safety—aside from salting risks—rests in good-sized samples as well as a large number of these. Locked leather bags are very handy to have along, and conduce to one's peace of mind. Even if the engineer feels morally certain that no one interested would tamper with him, he should endeavour to be in the position where he could always swear no one *has*. When put in the latter light to honest but sensitive owners a clearing of the atmosphere can usually be noticed.

Dumps are always open to suspicion, especially small ones, but nevertheless they should be closely studied as they may throw light on the mineralization, etc. Even a passing glance of a dump from a long cross-cut tunnel, caved at the end, but showing no quartz, might indicate that the prominent surface showings either did not go down or that the tunnel workings had not penetrated to them, despite the owner's assertions to the contrary. (Owner wanting the tentative purchasers to have the cleaning out done for their account).

But, after all, the engineer's best protection is common sense, power of observation, and ability to read human nature. He has to place more or less trust in others. The 'pumping' of the natives, getting their ideas of things in general, and of the special property in particular, is a helpful practice. For instance, if a series of exciting samples has been got from a mine out of which no such ore was known by the neighbours to have come before, it would behove the engineer to look out, and into, again.

Happily there is now, as Mr. Carter makes mention, much more talk of 'salting' than 'doing.' No doubt the world is getting better and the "bully honest miner," of Dan de Quille, is getting more honest; perhaps the decline of the custom of making cash-down payments may have something to do with it. And while on this subject the 'dressing' of a mine might be touched on, as it is apt to be

more bothersome than salting. By 'dressing' is meant, as I understand it, the preparing of the mine for a sale by the placing, and the stopping, of the openings where they will do the most good—grooming it, as it were. As in a horse trade, this sort of thing is not entirely and absolutely reprehensible. The owner, especially of a new property, would be, as a rule, foolish not to do his work at the most promising spots. And the seller is not bound to call attention to the weak points of the property—that is 'up to' the examining engineer. So this dressing process is apt to cause the engineer some worry in giving it the proper 'weighting' in the forming of his judgment. For it is nearly as bad to overlook a good property as it is to recommend a poor one.

W. N. CUMMINGS.

Tucson, Arizona, July 12.

[This is a subject of perennial interest. The suggestions made by Mr. Cummings should prove useful, especially to the younger members of the profession when engaged in 'scouting.'—EDITOR]

Pebbles for Tube-Milling.

The Editor:

Sir—Mr. Mackay's letter in your July issue with reference to the manufacture of pebbles at the Ceniza mill, near Parral, lacks many details, which I should have added to such a contribution had I considered the matter worthy of publication by itself.

With imported flints at the prohibitive price of £15 per ton, delivered at the mine, the question was not so much a comparison between the cost of imported and locally made pebbles as the difference of efficiency in the use of raw or prepared mine-rock. By giving the rock an eight or ten hour 'rounding-off' in the mill, and afterward sorting out the good pebbles resulting, a distinct advance over the ordinary practice in using mine-rock was made. The danger of chokage of the spiral feed was obviated, an occurrence that is common where a spiral of ordinary diameter is used, and jagged rock introduced to the feed. The mill (provided the feed was kept at the correct proportion of moisture), was operated at a maximum efficiency, and the usual troubles inside and outside, resulting from the use of raw mine-rock and the consequent formation of gravel and small pebbles (due, respectively, to chipping and, in some cases, fracture of the stone), were avoided. Every pebble introduced into the mill had been previously proved.

In the case of the Ceniza mill the explanation may be necessary that the fine-grinding department was ready before the rest of the equipment was erected, and the opportunity was taken to utilize it for the above purpose. It was soon found that a considerable tonnage of excellent pebbles could be prepared at a minimum of time and cost, each charge of raw rock filling the mill just over half-full.

Should the idea meet with the approval of other metallurgists situated where flint or especially tough stone is available, I would suggest the erection of a small mill for the especial purpose, fitted with ribbed liners, and with a possible arrangement of continuous feed of rock and a continuous discharge of pebble and gravel.

A. W. ALLEN.

London, September 5.

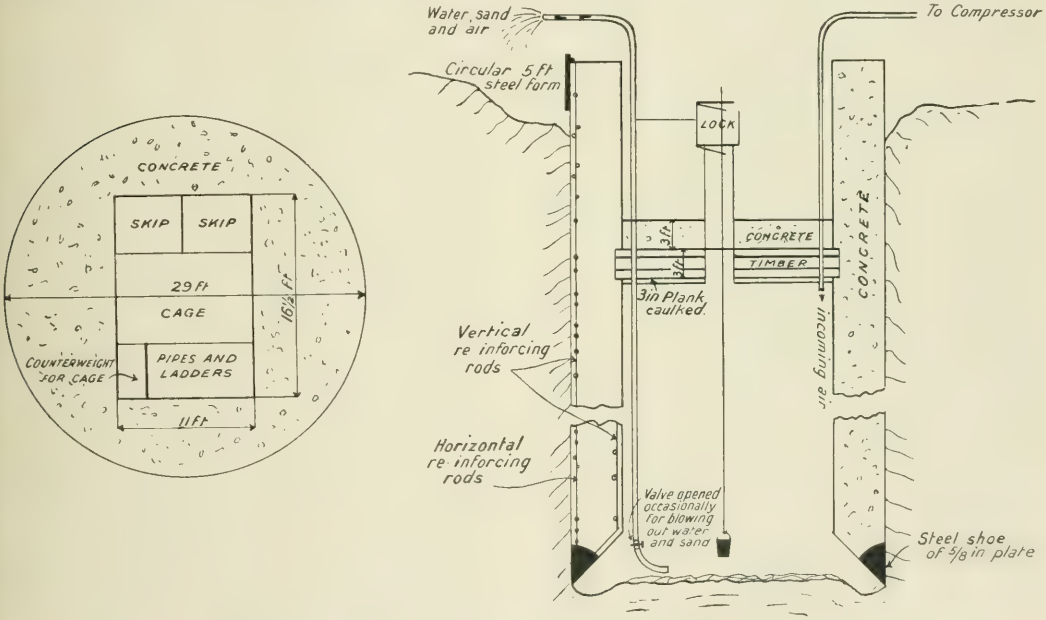
German Ironmasters are keenly searching for foreign supplies of iron ores. Large shipments are obtained from Lapland and it is an open secret that the iron resources of Morocco are the ultimate cause of the present political crisis. They are carrying their economic warfare with France nearer home by putting capital into Normandy especially at Briey. The output of this district during 1910 was1,605,000 tons, of which one half was used by French firms, and the remainder despatched to Belgium and Germany. The proportion sent to Germany will probably increase during the next few years.

A water-softening process, originated in Germany and already in successful use on the Great Northern railway in England, has recently been introduced into New York, and is arousing keen interest. The process has been installed on an experimental scale at one of the Standard Oil Co.'s plants, and also at a point on the New York Central railroad. It appears to be successful. The process consists in allowing boiler-feed water to flow in a thin film down a steeply inclined aluminium plate, exposed to the full rays of the sun. No chemical change between top and bottom of the plate can be detected, but on evaporation in a boiler, the water thus treated forms an impalpable sediment instead of the usual hard scale, and not only this, but it will decompose any scale previously accumulated from untreated water. The causes of this phenomenon are obscure, but the aluminium plate and the sunshine seem to be essential elements. After treatment, the water can be stored over-night, or through a cloudy season, without loss of its virtues.

PRÉCIS OF TECHNOLOGY

Alloys of Refractory Metals.—In *Metallurgical and Chemical Engineering* for July, Hans Goldschmidt, of Essen, discusses the solubility of refractory metals as affecting their alloying capacity. His reason for writing the article is that many users of refractory metals have an idea that, because those produced by his alumino-thermic process are free from carbon and therefore have higher melting points, they are not so suitable for alloying purposes. He points out that the alloying capacity of a refractory metal with one of lower melting point is not a function of the melting point of the former but of the solubility of the former in the latter. This contention is fully proved in practice. Carbon-free chromium melts at 2822° F, but is well known to alloy readily with molten steel. Carbon-free manganese melts at 2273° F. and alloys even better with copper than ordinary manganese. Ferro-titanium produced by the alumino-thermic process melts at 2426° F and dissolves easily and uniformly in molten steel. Experience generally shows that these carbon-free metals are actually more soluble than those containing carbon, though the latter have lower melting points. In explaining the theory of solution of one metal in another, Mr. Goldschmidt quotes the case of platinum which is soluble in tin and lead, and the consequent astonishment of the young chemist who tries to melt these metals in a platinum crucible.

Concrete Shafts.—In the *Mining and Engineering World* for May 29, P. B. McDonald describes the method of sinking through watery strata at the Rogers mine, Iron River, Michigan. Briefly, the method is a variation of that by which the shaft is built of reinforced concrete and sinks as the material is dug away from the cutting edge, by men in a compressed-air caisson. The shaft is 29 ft. outside diameter, but the cross section is not annular; instead, the internal space is made of rectangular cross-section 16½ by 11 ft., and is subsequently divided into compartments as shown. This construction forms the novelty in the present case. The steel shoe is about 4 ft. high, made in four segments, the steel being ⅝ in. thick, with vertical webs rivetted to the sides of the shoe by angle irons. The shoe after being built in position is filled with concrete. The earth is then dug out from the centre and the shoe gradually falls. As it does so, the walls are built up upon it with a circular steel form on the outside and wooden forms in the inside. Circular horizontal rods of ⅞ in. square steel are embedded in the concrete, and also two sets of vertical rods, one near the outside periphery and the other near the inside surface. When the shaft has sunk to a depth where much water and gravel come in at the bottom, preparations are made for the use of compressed air. A timber deck is built across the shaft, caulked with oakum, covered with concrete, and lined on the lower side with clay plaster. The men excavate for a few feet below the shoe and the material is drawn up by



HORIZONTAL AND VERTICAL SECTIONS OF CONCRETE SHAFT

bucket or by dredge. During this time the shaft does not fall owing to the atmosphere of compressed air. The men then come to surface and the air pressure is released, thus allowing the shaft to sink. The cycle of operations is continued until the work is completed.

Queensland Miners' Health Commission.—The *Queensland Government Mining Journal* for July contains the text of the report of a Commission recently appointed to investigate several points in connection with the health of underground workers in the mines of that state. The first field of inquiry was a general one relating to the "Conditions of work in relation to the health of the miners"; the second related to the amount of pulmonary diseases prevalent; and the third was a consideration of the expediency of preventing tuberculous subjects from doing mining work and of suitably compensating them for the loss of their employment. As regards general conditions the Com-

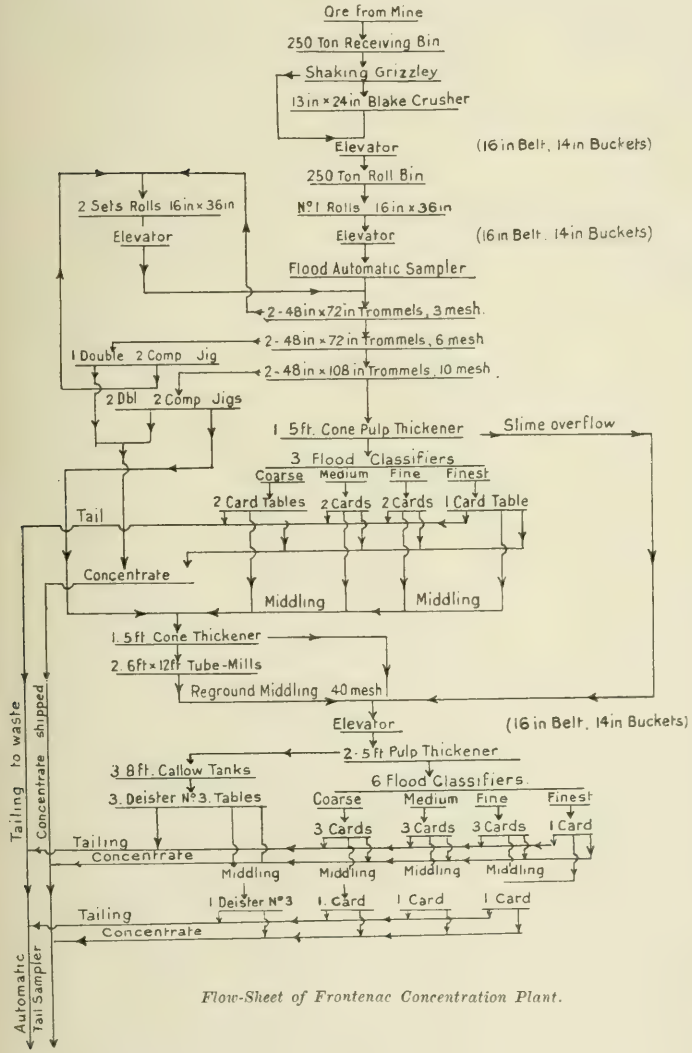
missioners are of opinion that the Regulation of 1910 relating to efficient ventilation (described in our issue of April last) is sufficient for the purpose of maintaining a pure atmosphere and of reducing the temperature of the workings, except perhaps at Charters Towers where the atmosphere in the deep mines is hot and moist. The law already allows inspectors to enforce the use of sprays or other allayers of dust in rock-drill operations, but the Commissioners recommend similar powers in connection with the handling of ore at other points such as after blasting and during loading into skips. They also have many recommendations about drinking water, sanitation, etc. Their enquiries into the subject of pulmonary complaints disclosed the fact that fibrosis and tuberculosis are prevalent only to a limited extent and are confined to dry and dusty quartz mines, but that they are gradually on the increase. The recommendations in Part 1 of the inquiry will go a long way toward improving the conditions, but the Commissioners are in favour of the additional drastic proposition under Part 3, namely that miners should be required to obtain medical certificates once a year to prove their immunity from pulmonary complaints, and that some sort of general insurance scheme should be inaugurated by the State to provide for such as are rejected. This part of the recommendations is of far reaching importance, and will raise much discussion in other countries as well as in Queensland.

Salt from Salt Lake.—In the *Engineering and Mining Journal* for July 8, Percy E. Barbour describes the methods of extracting salt from the waters of Salt Lake, Utah. This lake is about 75 miles long and 30 miles wide. It is quite shallow, being never more than 50 ft deep, and averaging 30 ft. The shores are flat, and even a small variation in the depth causes a large increase or decrease in its area. The level alters from year to year, and during the seasons of each year. When the level is low, the specific gravity of the water is higher than when more water is present, but the average is about 1·15, compared with 1·02 of sea water. With the exception of the Dead Sea the water is the densest known. It contains from 15 to 22% by weight of salts, or nearly five times as much as the Atlantic Ocean. The accumulation of salt is due to the evaporation of the water from tributary streams which bring down small proportions of saline matter. An analysis of the water gives the following contents in grammes per litre: Sodium chloride 193; magnesium chloride 15; potassium sulphate $8\frac{3}{4}$; sulphate of lime $8\frac{1}{4}$; magnesium sulphate $5\frac{1}{4}$; lithium sulphate $\frac{1}{8}$. Two companies are engaged in making commercial salt from the water; the larger of these two firms is the Inland Crystal Salt Co. of which J. F. Smith, the head of the Mormon church, is president. At this company's works the water is pumped during May each year to settling ponds two miles away by pumps that handle 7000 gal. per minute. In these ponds the solid foreign matters are deposited, and evaporation proceeds until the salt content is raised from 15 to 22% by weight. The brine then goes to 'stock' ponds where further evaporation brings the salinity to 26%, and afterward to 'harvesting' ponds where the salt crystallizes upon a prepared floor of salt. There are 35 'harvesting' ponds of 9 acres each, but only 10 or 15 are at present in use. The salt deposited varies from 2 to 6 in. in thickness and, after the remaining liquor has been drained off and returned to the lake, the salt is ploughed by horse-power and stored in piles at the side of the ponds. Naturally the weather has considerable effect on the process in many ways, the humidity and rainfall lengthening the time of evaporation and the latter sometimes dissolving much of the salt in the piles during the autuum. In 1910 the acreage 'harvested' was 100, from which 50,000 tons was removed, or 500 tons per acre. This however was an exceptional year and 250 to 300 tons is nearer the average. Corresponding figures at the French Atlantic works where sea-water is evaporated are 0·6 to 11 tons, at the French Mediterranean works 12 to 23 tons, and at the Corsican works 68 tons per acre. The crude salt produced by the Inland Crystal Co. contains 97·85% sodium chloride, 1·5% water, and the remainder consists of small quantities of other salts. Some of the crude salt is sold without further treatment, and some is refined for table use, until it contains 99 5% NaCl.

Concentration at Frontenac Consolidated.—In our issue of May 1910 we quoted the prospectus of a company formed in London to acquire the Frontenac and Aduddel gold mines situated near Central City, Gilpin county, Colorado. It has been possible to re-open these old mines owing to the fact that the Newhouse tunnel has intersected the vein at 1800 ft. below surface. The ore consists of a mixture of pyrite, galena, and tetrahedrite in a quartz gangue. The gold content averages 6 to 7 dwt. per ton and is found chiefly in the pyrite; in addition 4 to 6 oz. silver is present associated with the tetrahedrite. Until recently the ore was treated in the usual local way by amalgamation and concentration. On the formation of the English company it was decided to bring the treatment up to date, and, as little precious metal is associated with the quartz, to omit the amalgamation. *Mining Science* for July 20 describes the new concentrating plant which has been designed by Henry P. Lowe, managing director, and S. B. Tyler, superintendent. The plant is capable of treating 200 tons per day and produces five different classes of concentrate. The ratio of concentration is 4 to 1, and the recovery is 85% of the gold and 78% of the silver content. The accompanying flow-sheet explains the treatment. The ore is broken to 2 inch size and then passed to three sets of rolls. The first rolls are spaced 1 in. apart and the discharge is sent to a trommel having apertures corresponding to 3 mesh. The oversize goes to second rolls, and the ore passing through is sent to a second trommel with 6 mesh aperture. The oversize from these goes to the coarse jigs from which the tailing goes to the second rolls. The ore passing the second trommel goes to a third trommel with 10 mesh aperture, the oversize of which goes to second jigs. The tailing from the second jigs goes to the tube-mills. The hutch product of the two sets of jigs consists of galena and pyrite. The undersize from the last trommels passes to a cone thickener, from which the overflow is sent to the slime department, and the thickened pulp goes to Flood tube-classifiers where four sizes are produced. These products are treated on Card tables which yield concentrates of galena and pyrite. The lead concentrate carries a large proportion of gold, and the pyrite carries copper, and the two about equally share the silver. The tailing contains practically no lead. The middling from the four sets of Card tables joins the tailing from the second jigs and the mixture is sent to tube-mills (of which only one is in use at a time) where it is reduced to 40 mesh. The discharge is mixed with the slime overflow of the thickener above mentioned and sent to another thickener, from which the overflow goes to Callow tanks and to No. 3 Deister slime-tables, while the underflow goes to Flood classifiers and to Card slime-tables. The middlings from the Card and Deister tables are re-treated on second tables without any re-grinding. The slime concentrate contains cop-

per and silver with some gold. The following table gives particulars of the contents of the various concentrates:

Concentrate.	Gold, Oz. per ton.	Silver, Oz. per ton.	Lead %	Copper %	Silica %
Jigs	0·70	12	10	1·2	10
Card Iron	0·60	11	—	2·0	9
Card Lead.....	5·00	12	37	—	—
First Slime	0·45	12	—	3·0	20
Second Slime...	0·40	12	—	3 to 4	30


Ore from Mine
250 Ton Receiving Bin
Shaking Grizzley
13 in × 24 in Blake Crusher
Elevator
(16 in Belt, 14 in Buckets)
250 Ton Roll Bin
2 Sets Rolls 16 in × 36 in
No 1 Rolls 16 in × 36 in
Elevator
Elevator
(16 in Belt, 14 in Buckets)
Flood Automatic Sampler
2 - 48 in × 72 in Trommels, 3 mesh.
2 - 48 in × 72 in Trommels, 6 mesh
1 Double 2 Comp Jig
2 - 48 in × 108 in Trommels, 10 mesh
2 Dbl 2 Comp Jigs
1 5 ft. Cone Pulp Thickener
Slime overflow
3 Flood Classifiers
Coarse Medium Fine Finest
2 Card Tables 2 Cards 2 Cards 1 Card Table
Tail
Concentrate
Middling
Middling
1 5 ft Cone Thickener
2 6 ft × 12 ft Tube-Mills
Reground Middling 40 mesh
Elevator
(16 in Belt, 14 in Buckets)
2 - 5 ft Pulp Thickener
3 8 ft. Callow Tanks
6 Flood Classifiers
3 Deister No 3 Tables
Coarse Medium Fine Finest
3 Cards 3 Cards 3 Cards 1 Card
Tailing
Concentrate
Middling Middling Middling Middling
1 Deister No 3 1 Card 1 Card 1 Card
Tailing
Concentrate
Tailing to waste
Concentrate shipped
Automatic Tail Sampler

Flow-Sheet of Frontenac Concentration Plant.

As already mentioned 85% of the gold and 78% of the silver is recovered; the following table shows how the recovered metals are distributed in the various concentrates:

Concentrate	%
Jig.....	18
Card Iron	44
Card Lead	6
First Slime	29
Second Slime.....	3
Total.....	100

Concentrating Silver Ore at Cobalt.—The *Canadian Mining Journal* for July 15 contains a paper by A. P. Globe, mill manager of the McKinley Darragh mine at Cobalt, Ontario, describing the concentration plant erected there. The ore as it comes from the mine is hand-picked in the first grizzly, and also after coarse breaking. It is then crushed to 1¼ in. and screened, the oversize being sent to coarse jigs, and the undersize sent together with the hutch product of the jigs to another screen. From the latter the oversize goes to a fine jig, and the undersize separated into sand and slime. The slime forms about 1% of the total ore and averages 200 oz. silver per ton, so it is not concentrated further but shipped direct to the smelter; the sand goes to the Wilfley tables mentioned hereafter. The tailing from the coarse jigs goes to a battery of 30 stamps, from which the pulp is classified, the oversize going to a Hardinge conical mill together with the tailing from the fine jig. The combined pulp is classified and sent to Wilfleys, Deister tables and Frue vanners. The tailing from the Wilfleys is re-ground in a tube-mill and treated on a Deister table and Deister slime-tables. The tailing from the Frue vanners is passed over Deister slime-tables. All the slime-tailing is passed over canvas sheets. The average assay of the ore is 43 oz. silver per ton and of the final tailing 4 oz., giving an extraction of 90%. According to the present arrangement very little rich ore is removed by hand-picking, but before long a more elaborate plant will be erected for this purpose. The cost of concentration is low, being only $1·30 per ton milled

Ore in Clay Selvages. — At the June meeting of the American Institute of Mining Engineers, Charles R. Keyes presented a paper discussing the origin of silver bonanzas in the arid regions of the United States and Mexico. He agrees that these deposits are not derived from below, but are due to meteoric and other descending waters charged with salts. In every case known to him they are associated with the clay selvage of brecciated and sheared belts, joints and fracture crevices, and fault-planes. The miners as a rule follow the clay, but engineers have only casually referred to the fact that the silver is found richest at these spots. Mr. Keyes takes up the subject and founds the theory that descending waters containing salts will precipitate their valuable bases on coming into contact with the alkaline silicates of the clay. He quotes Lindgren and Emmons, who have shown that the presence of kaolin is *a priori* evidence of downward sulphide enrichment, and urges that the theory is of wider application than either was aware. He believes that similar phenomena are to be found in almost every type of deposit wherever there are descending waters charged with salts, but they are specially noticeable in desert deposits, because the thickness of the gossan zone is

great, and this feature is therefore prominent and characteristic. The above is a mere outline of Mr. Keyes' chief proposition; his paper should be read in full. We may add that his argument is based by analogy on researches connected with agricultural chemistry.

The Aluminium Industry.—*The Electrical Review* (London) quotes a paper by W. Kossmann and published at Strassburg, on the economic development of the aluminium industry. Mr. Kossmann gives 175 metric tons as the production in 1890. This had increased to 7300 tons in 1900, 11,500 tons in 1905, and 34,000 tons in 1910. The following are the present producers of the metal and their individual outputs for 1910:

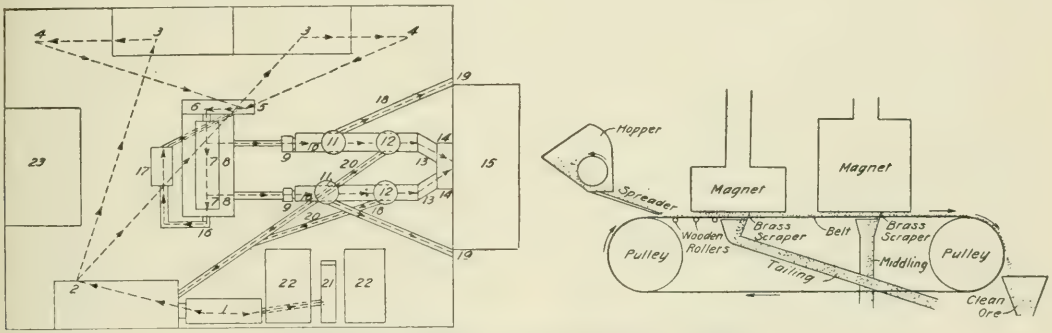
Companies	Country	Production in Metric tons in 1910
Aluminium Industrie Gesellschaft, Neuhausen, etc. ...	Switzerland, Austria, and Germany	6000
Societe Electro-Metallurgique Francaise, Froges ...	France	6000
Compagnie des Produits Chimiques d'Alais et de la Camarque, Salindres	France	2500
British Aluminium Co.	Scotland	4000 to 5000
Aluminium Company of America	United States	12,000
Northern Aluminium Co.	Canada	
Societe des Forces Motrices et Usines de l'Arve ...	France	600
Societe des Produits Electro-Chimiques et Metallurgiques des Pyrenees	France	500
Societe Electro-Metallurgique du Sud-Est	France	300
Societe d'Electrochemie	France	300
Gebruder Giulini, Ludwigshafen	Switzerland	400
Societe Italiana per la Fabbricazione dell' Aluminio ...	Italy	600
Anglo-Norwegian Aluminium Co.	Norway	500

The first five in the list account for 90% of the output. France and North America are about equal in point of production and are substantially in front of any other country. It is notable that only one works is in Germany, that at Rheinfelden, Baden, belonging to the Neuhausen Co.; the relative importance of German production has changed entirely during the past ten years. Water power has been a more important factor in locating the works than the supply of the raw material. The price was as much as £50 per kilogramme in 1855. In 1890 the quotation was 27s. 6d.; 2s. in 1900, 3s. 3d. to 3s. 9d. in 1905, 1s. 3d. to 1s. 6d. in 1909, and 1s. 3¾d. to 1s. 7½d. per kilogramme in 1910. Until 1901, when the price averaged 2s. 2½d., the price had continued to fall rapidly. But in the course of that year a syndicate was formed by the Neuhausen Co., the French works at Froges and Salindres, and the English and American companies. The syndicate played a determining part in the course of prices in the succeeding years; and both prices and production increased. It is possible that the advance in the output was mostly due to natural conditions, but the price movement is explained solely by the action of the combination. The early years of the syndicate's activity proved to be extremely favourable; the production developed in proportion to the demand, and the syndicate was able to raise the price temporarily in 1907 to 4s. per kilogramme. Owing to the advance in price, the profits of the companies increased, and raised the hope that it would be of a lasting character. All the works were extended, and when the Heroult patents expired in 1905, new companies were formed, and their plants were completed in 1907. The productive capacity was thereby largely increased, and the works outside the syndicate began to place aluminium on the market below the convention prices. During 1908 the management of the syndicate was compelled to reduce the price several times without attaining the desired results, and the syndicate was dissolved at the close of September in that year, when the price further declined in consequence of the competition for orders. Contracts were even concluded at the close of 1908 at 1s. 1¼d. per kilogramme, a rate which is declared not to have covered the costs of most producers.

The author states that the syndicate fixed the division of the total quantity to be offered for sale among the members according to a percentage basis, whilst, at the same time, specified markets were allotted to the companies individually. The relation of the Pittsburg Reduction Co. (the former name of the Aluminium Co. of America) to the syndicate, was slack from the beginning. The fact that this company erected works in Canada, that were subsequently made an independent undertaking, and was built for export purposes exclusively, shows that there were powerful interests in opposition to the European producers. The management of the syndicate was not exercised jointly by members, but lay in the hands of the Neuhausen Co. The company owed this position to its great experience and success and to the circumstance that it was the largest producer in Europe at that time; the company's output was almost one-third of the world's production, whilst the two French companies were responsible for 20%, and the English company for 8%. But this proportion has completely changed. The effort made to revive the syndicate in the second half of 1909 led to an improvement in prices, but the negotiations were unsuccessful. Nevertheless an important step in this direction is recorded in the combination, which the French producers formed in November 1910, under the lead of the Frankfort Metallgesellschaft. It is considered an open question whether the French organization will lead to the constitution of a new syndicate to control the trade of the world.

Rhodesian Tin.—J. M. Moubray, in the *Rhodesian Mining Review* for July 5, gives details of the occurrence of tin ore in the Abercorn district. This belt measures about ten miles east and west by two miles wide and is situated eight miles south of the Shamva gold mine. The rocks of the district are pre-Cambrian with an east and west strike and dipping north at a

steep angle. They have been tilted into this position by the granite which is found immediately to the south of the belt. They consist of schists, altered phyllites, banded ironstones, ironstone breccias and conglomerates, and limestones. Many acid and basic dikes have penetrated the rocks. The basic dikes are of no importance from the point of view of the occurrence of tin; they vary from fine grained epidiorite to a coarse diabasic rock consisting almost entirely of pyroxene. The acid dikes are of a pegmatite nature and may be divided into three classes. Those of the first division are typical pegmatite containing quartz and felspar in nearly equal proportions, and as a rule no mica; no cassiterite has yet been found in them. The second class is the largest, and cassiterite is only found occasionally; felspar predominates, and quartz and fine-grained lepidolite mica are usually present. The third class are composed wholly or in part of greisen formed by the removal of the felspar from the original pegmatite and the deposition of muscovite mica and cassiterite. The muscovite varies in colour from yellowish white to green and brown. The cassiterite occurs in all sizes from crystals two inches long to the finest grains. Some of the outcrops of the dikes have



REMOVING PYRITE FROM BLENDE AT JOPLIN.

carried as much as 20% tin, and at the bottom of shallow prospecting shafts below the zone of surface decomposition several assays of 7½% tin have been obtained. Mr. Moubray does not say anything about the width of the dikes or of the pay-streak. With the cassiterite are associated garnet, magnetite, and occasionally tourmaline.

Removing Pyrite from Blende.—Lucius L. Wittich in *Mines and Minerals* for August describes the magnetic separating plants which treat practically all the complex blende-pyrite ores of Missouri-Kansas-Oklahoma. The galena and blende ores found in that district are usually free from iron or have so low a content as not to cause any serious deduction in price; or, we should say, the comparatively pure ores are found in sufficient quantity to make it possible to postpone the consideration of any other quality. In some parts of the district impure ores have been mined but left on the dumps. Only one company is concentrating these complex ores. This is the Joplin Separating Co., which has two plants, one at Joplin and the other at Galena, the latter being the larger. The company does not own mines but buys ore and dump material from various producers. Mr. Wittich describes the operation of the plant at Joplin. The ores are first jigged to remove galena and gangue, the sizing screen being shown in the accompanying flow-sheet at (*1*) and the jigs at (*2*). The blende-pyrite concentrate there produced is sent to two roasting hearths (*3*) capable of treating 9 short tons in 12 hours. A glowing red heat is maintained until the blue sulphur flames disappear, and the pyrite has been sufficiently oxidized. The ore is then discharged upon cooling floors (*4*) and afterward transported to the hopper (*5*) from which it is raised by a cup-elevator (*6*) to the revolving screen (*7*). The first half of the screen is made of wire with openings ⅛ in. square, and the lower half of sheet iron having ⅛ in. round punched holes. The two sizes thus obtained fall into two divisions of the hopper (*8*); the oversize is sent to rolls (*17*), and the ground material returned to the hopper (*5*). The contents of the two divisions of the hopper (*8*) are delivered by two sets of magnetic separating apparatus. The material is spread upon travelling belts (*10*) which pass first under weak magnets (*11*) and then under stronger ones (*12*). These magnets revolve, and as they swing round, brass scrapers remove the adhering magnetic material. The first magnets range in power from 2 to 5 amperes according to the nature of the ore, and they remove all the free iron oxide, which is sent to the dump (*19*). The second magnets carry 9 to 12 amperes and they attract particles of mixed ore. A piece of ore containing one part of iron to 50 of blende will be removed. This middling product is returned to the jig-house (*2*) where it is treated by separate apparatus. Here it is sized. That which passes 3 mm. goes to the jigs, and that passing 1 mm. and ¾ mm. goes to tables, while the oversize is sent direct to the rolls (*17*) and returned to the magnetic separators.

Hoisting by Compressed Air.—*Mining Science* for July 27 contains a brief outline by Charles Copenharve of the new compressed-air plant now being erected at Anaconda for hoisting the ore from the mines. The economic problem in connection with the installation of a new power plant to replace steam engines has been complicated by the prejudice on the part of the miners against electric hoists. The group of mines now managed by the Anaconda company had in use 25 steam-driven hoists having a total horse-power of 40,000, but as the service was intermittent probably not more than 4000 hp. was required regularly. It was obvious therefore that this method of operating the hoists was uneconomical. As the company has its own coal mines it was intended at first to erect a central electric generating station for the supply of all the power required for every purpose. On working out the necessary figures it was found that purchased electric power came much cheaper, the price being $25 per horse-power-year, as compared with $80 in the old days of separate steam units. The current comes

from the Rainbow falls on the Missouri river a few miles below Great Falls, Montana, and is transmitted to Butte, 130 miles, at 100,000 volts. With the exception of the hoists, the whole of the plant for underground hauling, pumping, etc., will be operated electrically. The hoists were excepted partly because it was supposed that electricity is not suitable for deep mines and partly on account of the prejudice against it on the part of the miners. Under these circumstances it was deemed best to operate all the hoists by compressed air supplied from a central air-compressor operated electrically. This plant contains three motors rated at 1200 hp. but easily capable of taking 1500 hp. Each is coupled direct to the fly-wheel of an air-compressor. The air is compressed to 90 lb. and is delivered to a great equalizing reservoir consisting of 32 receivers each 10 ft. diam. by 30 ft. high. The internal pressure is maintained by hydrostatic water supplied from a tank 100 ft. diam. and 15 ft. high built in a situation above the receivers. Thus the individual hoisting plants always receive their air at the same pressure however many of them happen to be operating at the same time. An advantage of this method of distributing power is that the electric current consumed is constant throughout the day. It is estimated that the new power plant, electric and compressed-air, will reduce the cost of producing copper by one cent per pound.

Amalgamation on the Rand.—At the June meeting of the Chemical, Metallurgical, and Mining Society of South Africa, J. E. Thomas contributed to the discussion on W. R. Dowling's paper on this subject, by giving the comparative results at the Simmer Deep-Jupiter plant before and after Mr. Dowling's method was adopted. By the old arrangement 235 stamps had 3351 sq. ft. of amalgamating plates and 7 tube-mills with 1925 sq. ft. of shaking plates at a slope of 10%. By the new arrangement the battery plates are omitted and 1700 sq. ft. of stationary plates placed below the tube-mills. The proportion of liquid to solid in the pulp flowing over the tube-mill plates has been decreased from 2 : 1 to 1·1 : 1, the aperture of the battery screen increased from 0·0461 in. to 0·0685 in., the number of stamps decreased from 235 to 220, the number of tube-mills increased from 7 to 10, and the tonnage per 24 hours increased from 2125 to 2243. The extraction by amalgamation was 56·8% by the old method, and 55·52% by the new, and the total extraction 93·38% by the old and 94·23% by the new. Careful examination revealed no amalgam in the cyanide pulp.

Charcoal in Cyanide Tailing.—In the *Monthly Journal* of the West Australian Chamber of Mines for June, V. T. Edquist gives an account of the method of re-treating cyanide slime from the Great Boulder Perseverance at Kalgoorlie. This slime was originally produced at the mine by dry-crushing, and it was transported thence to Lakeside, three miles away, for cyanide treatment. The filter-press residue was moist and sticky and would not readily discharge from the cars, so the inside of these was sprinkled with wood-ashes. In consequence of this, the tailing heaps contain large amounts of charcoal which has precipitated much of the gold left in the solution or subsequently dissolved by it. When it was decided to re-treat the dumps which average 2½ dwt. gold, it soon became obvious that the charcoal must be separated and treated separately. The dump material after being sent to mixers, is passed through a trommel with $\frac{3}{16}$ in. holes. The larger portions of charcoal and other vegetable matter are here caught together with any nodules of slime that have not been disintegrated. This is all sent again to a mixer with an excess of water so that the nodules may have another chance of being broken. The final charcoal product, obtained after a second screening, contains from 20 to 40 oz. gold per ton. The finer charcoal that passes the trommels flows to the vats and floats during agitation, and it is removed by hand-skimming. The mixed coarse and fine charcoal products are burnt and the leavings sold to smelters. The amount of gold thus recovered averages 5 grains or 8d. per ton of slime. Associated with it is about 3% of silver, as compared with 18% of silver obtained with the gold extracted from the slime by cyanide.

Modified Square-Set.—In the June *Proceedings* of the Australasian Institute of Mining Engineers there is an interesting paper by A. J. Moore advocating the adoption of a modified form of square-set, which he might call a triangle-set. He points out that the ordinary square-set as used nowadays is only a scaffolding and does not help very much to support the walls. When originally introduced by Deidesheimer for mining the large lodes at the Comstock, it had the elements of strength in its construction in the wall-plates and the diagonals. These were gradually discarded in order to reduce expense, and safety was ensured instead by resorting to filling the exhausted stopes with waste as soon as possible. Broken Hill provides a good example of this application of the method. Mr. Moore founds his criticisms of the square-set on Broken Hill practice. Though his paper contains only a proposition and not a record of practice, it is of interest to the mining engineer and should arouse discussion. We reproduce here a diagrammatic cross section of a lode showing the system (Fig. 1), an enlarged view of the timbering (Fig. 2), details of the joint (Fig. 3), and the drift set (Fig. 4). The method is to make the timbering in the planes at right angles to the lode in triangular set and to space these apart by struts parallel with each other. The triangulated frames (Figs. 1 and 2) are calculated to bear the pressure of the wall and back, while the struts do not have to bear much pressure, only serving to hold the frames in place. Any portion (M) of the rock (Fig. 1) coming against a joint will be supported by the line of caps (AC) and the line of posts (AB). If any link, say the cap (mn), fails, the pressure along (Am) will be split along (mp) and (mq). At (p) and (q) there are three members that can take up the pressure, and eventually the whole structure will assume some part of the stress. Similarly when an isolated weight from the back comes on a joint every member of the structure shares the stress. It will be seen that unexpected and irregular pressures are not likely to upset the timbering as in the case of the square set, and the timbers need not be so massive at the joints in order to secure stability. The caps and struts could be made of timbers 10 by 8 in. and the diagonal posts of 10 by 6 in. timbers all with their widest sides downwards. The inclination of the diagonal posts would depend to some extent on the dip of the lode; in the illustration it is 65° with the horizontal. The distance vertically between the centre lines of the caps is 8 ft. and the length of the caps is 7 ft. 6 in. The frames are 5 or even 6 ft. apart. For a drift-set two diagonals would be removed and 10 by 10 in. uprights would be placed under each end of the cap, and similar timbers would be used for reinforcing the other diagonals in the manner shown in Fig. 4. As regards the joints (Fig. 3), the caps butt against each other by tenons 5 by 5 by 3½ in.; the strut tenons are 7 by 5 by 2½ in. and the diagonals are bevelled by 1½ in. The caps have a bearing surface of 2 in. on the diagonals the full width in addition to the tenon. These joints will be more expensive to cut than those

of the square-set, but on the other hand they are much stronger. An advantage is that the total amount of timber used is not greater, and each member is lighter and easier to handle. In many cases waste-filling will not be required at all, and in any case it will not be necessary to fill so regularly or so often. The drift-set is much stronger, and chutes can be put in more easily. There is a greater proportion of the timber in the frames across the lode.

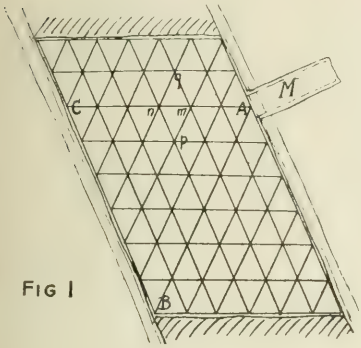


FIG 1

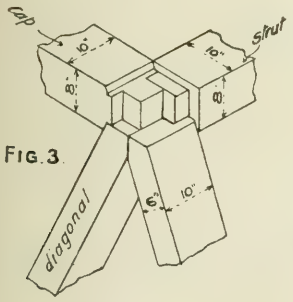


FIG. 3

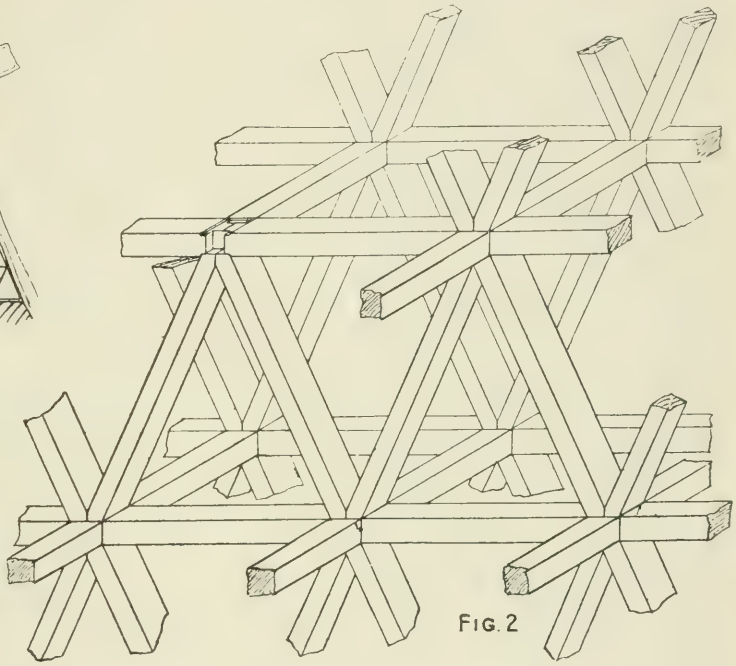


FIG. 2

Sintering Iron Ores.—In the *Bulletin* of the American Institute of Mining Engineers, James Gayley contributes a paper on the sintering of iron ores by the Dwight-Lloyd straight-line or 'conveyor' machine. As we gave an illustrated account of this invention in our issue of August 1910, it is not necessary to recapitulate details of the plant and process on this occasion. Suffice it to say that the sintering flame is drawn down upon and through thin layers of fine ore by means of a suction pipe below the series of travelling receptacles containing them. The process has been successful in connection with lead, copper, and other sulphides, and it has attracted the notice of iron metallurgists, who have long been seeking a means of agglomerating flue-dust, fine ore, and magnetic concentrate. Many processes have been proposed and adopted, such as nodulizing and briquetting, but none of these give perfect results; in all cases the lumps if strong enough to stand the burden of the blast-furnace are difficult to smelt. Experiments with the Dwight-Lloyd machine show that the product is cellular and coherent, in fact in ideal condition for blast-furnace requirements. Fine iron ore, except flue-dust, contains no combustible constituent as is the case with sulphides, so it is necessary to add about 7% of coal to the charge. Mr. Gayley gives much information as to the working of the machine and quotes the results obtained in a number of cases.

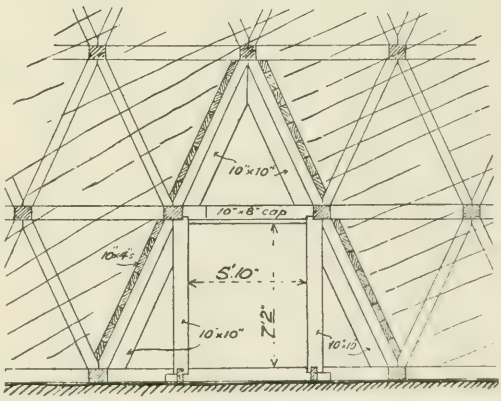


Fig. 4.

Chalcocite as a Primary Mineral.—In *Economic Geology* for June, F. B. Laney describes the copper ore deposits of the Virgilina district which is situated on the borders of North Carolina and Virginia. The sulphide ores consist of bornite and chalcocite, with only microscopic traces of chalcopyrite. The level of the ground water is from 50 to 75 ft. below the surface, and the zone of secondary alteration does not go below 250 ft. The chief mines are down from 350 to 500 ft. and at the deepest points there is as much chalcocite as bornite. In the upper levels the relation of the two minerals is such that a large part of the chalcocite may be taken to be secondary and more recent than the bornite, but in the lowest levels the two minerals are so intimately intergrown that the only conclusion possible is that they are genetically

contemporaneous. As chalcocite is usually regarded as a mineral of secondary origin, the Virgilina deposit is of special interest to economic geologists. Mr. Laney gives a complete account of the geology of the district and of the mineral constituents of the veins, with excellent micrographic pictures showing the intimate disposition of the minerals.

Cyaniding Ohinemuri River Sand.—In our issue of September 1910, Arthur Jarman gave an account of the blocking of the river Ohinemuri by the tailing discharged into it by the Waihi and other gold mines in the Thames mining district, New Zealand. He mentioned that a company, the Waihi-Paeroa Gold Extraction Co., was being formed for the removal of the sand that has accumulated in the river bed and for its treatment by re-grinding and cyanidation. In the June *Proceedings* of the Australasian Institute of Mining Engineers, Robert M. Aitken describes this scheme in detail. Up to the end of 1900, the total amount of tailing discharged into the river was about 500,000 tons. Since then the output of the mines has greatly increased, until now the yearly tonnage is nearly 600,000. Probably the total output to the end of 1910 was 5 million tons. It is only recently that fine grinding and extraction of the contents of the sand residue have been adopted, so that the average value of the tailing accumulated in the river is sufficiently high to make its re-treatment a profitable proposition

The Ohinemuri is a small river having a fall of 20 ft. per mile over the stretch of 10 miles from the Waihi to the Talisman and Crown mines. The tailing does not deposit to any great extent along this part of its course, but the river afterwards debouches into flat lands on which the town of Paeroa stands. This tract forms an excellent settling basin for the sand-tailing. The river is tidal and it is full of vegetable growth. The flow is just sufficient to carry away the slime, from which the gold has been extracted, but allows the sand to settle. So great is the accumulation that for four miles the average depth of the water has been reduced from 20 ft. to as many inches. The deposit has been carefully sampled by drilling. The finer sand near the banks averages 8s. 4d. per ton, of which 6s. 1d. is gold and 2s. 3d. silver, and the coarser sand in the bed gives from 8s. 4d. to 10s. gold, and 2s. 10d. to 3s. 4d. silver. A plant for treating the deposit is being built 2 miles below Paeroa, and the method of extraction closely follows that now in use at the Waihi and the Grand Junction. Twenty tube-mills will each reduce 25 tons per day to pass 200 mesh, and cyanide solution will be used in them. Subsequently the slime will be treated in Brown agitators (Pachuca vats) and the solution extracted in filters of the Moore submerged type. An important point that arose was the loss of gold and silver due to the presence of charcoal which had been dumped into the river by the power stations of the various mines. The sand has therefore to be preliminarily screened before going to the tube-mills and also sent over 'Union' vanners, which not only separate the smaller portions of vegetable matter but remove some of the barren sand. The charcoal so caught contains gold so it is burnt and the residue smelted.

As regards the method of collecting the sand from the river, the author and P. N. Kingswell, after much experiment, decided to use an air-lift dredge. The air-lift is a telescopic 10 in. pipe with a delivery chute at the top; the compressed-air escapes upward from a pipe at the bottom, and a number of water jets driven by a centrifugal pump, and easily controlled, play round the bottom edges for the purpose of loosening the sand and of making the upward current contain equal volumes of water and sand. The air pressure is sufficient to raise this mixture 4 ft. above water level. The mixture discharges into belt bucket-elevators which carry it to barges. When full the barges are towed by oil launches to the treatment plant, where the sand is removed by similar elevators, and after screening discharged into ferro-concrete storage reservoirs.

CURRENT LITERATURE.

Electric Winding. — The *Journal* of the South African Institute of Engineers for June contains a paper by T. P. E. Butt on the new electric plant at the Randfontein Central mine, with special reference to the electric winding engines. The paper is lengthy and full of useful details and drawings.

Prevention of Overwinding.—The *Iron and Coal Trades Review* for August 4 describes Dalglish's apparatus for the prevention of overwinding in mine-hoists.

Laying Dust.—At the meeting of the North of England Institute of Mining and Mechanical Engineers held in August, W. M. Thornton read a paper detailing experiments with soap, oil, and other solutions and emulsions, undertaken to ascertain their efficiency in keeping mine dust wet or of binding it into larger pieces.

Drill for Deep Holes.—The *Mining and Scientific Press* for July 29 contains an article by G. H. Gilman describing a new drill for deep holes, invented by C. H. Locher, that is claimed to overcome the difficulty of cleaning the holes made by drills of the churn type.

Cost Records.—In the *Proceedings* of the Australasian Institute of Engineers for June, T. H. Palmer & R. Ross describe the method of keeping the record of costs at the Broken Hill Junction North mine.

Modder B. Equipment.—The *South African Mining Journal* for August 5 contains a description of the Modderfontein B surface equipment. We gave an outline of the metallurgical method adopted in our February issue.

Earth Dams.—In the *Bulletin* of the Mexican Institute of Mining and Metallurgy, No. 3, 1911, John M. Nicol describes the building of dams filled with earth that has been transported hydraulically. He criticizes the construction of the first Necaxa dam which failed two years ago.

Crane's Ore Washer.—In the *Engineering and Mining Journal* for July 22, H. M. Adkinson refers to the advantages to be gained by careful hand-sorting of ore, and describes the combined trommel and washer invented by F. J. Crane for eliminating the finer ore and washing the coarse ore that is to be picked.

Concentration of Tungsten Ores.—In *Metallurgical and Chemical Engineering* for August, H. C. Parmelee continues his study of methods of concentrating tungsten ores and old dumps, especially in connection with Colorado practice.

Dredging in Colombia.—In the *Mining and Scientific Press* for July 22, Charles Janin writes on gold dredging in Colombia, more particularly describing the operations on the Cauca and Nechi rivers.

Geology of Oil Deposits.—*Economic Geology* for June contains a paper by M. R. Campbell, giving a historical review of the various theories advanced by American geologists relating to the origin and accumulation of oil.

Literature of Ore Deposits.—*Economic Geology* for June contains an article by F. L. Ransome reviewing the literature relating to ore deposits published in 1910.

Titanium Ores.—The *Bulletin* of the Imperial Institute, No. 2, 1911, contains an article giving a résumé of information relating to the distribution and uses of titanium ores.

Philippine Islands.—The *Mining and Scientific Press* for July 8 contains an article by Warren D. Smith on the economic geology of the Philippine Islands.

Iron Resources of Canada.—A. B. Willmott contributes a paper to the *Quarterly Bulletin* of the Canadian Mining Institute for April on the iron ore resources of Canada.

Bolivian Tin Deposits.—In the *Engineering and Mining Journal* for August 19, Miltiades Armas, formerly manager for the La Paz Mining Co., gives a geological description of tin ore deposits in Bolivia.

South African Tin.—The *South African Mining Journal* for August 5 contains articles on Swaziland tin gravels, on the Government geologists' latest report in the Waterberg tin district, and on the Nylstroom tin mine.

Zaaiplaats Tin. — The *South African Mining Journal* for July 22 contains Hans Merensky's report on the Zaaiplaats tin deposits in the Waterberg district of the Transvaal. Hitherto it has been supposed that the ore was confined to pipes of limited extent, but recent observations lead Mr. Merensky to the opinion that the pipes are shoots from main lodes and he is recommending that work shall be done on a larger scale and the metallurgical plant extended.

Wolfram in Queensland. — The *Queensland Government Mining Journal* for July describes the Mount Carbine wolfram district, with special reference to the concentration plant erected by the Irvinebank company.

Thorium Minerals.—The *Bulletin* of the Imperial Institute, No. 2, 1911, contains two notes on ores containing thorium; one describes several alluvial concentrates obtained in the Federated Malay States containing cassiterite, ilmenite, and thorium and cerium oxides, and the other some monazite sand from Travancore, India.

Artificial Covellite.—In the Columbia *School of Mines Quarterly* for July, Austin F. Rogers describes many occurrences of covellite which are apparently replacements of sphalerite, and he describes experiments whereby covellite can be formed by acting on sphalerite with copper sulphate solution.

Pachuca Vats. — In the August *Bulletin* of the American Institute of Mining Engineers, Huntington Adams describes the continuous method of operating Brown agitators, otherwise Pachuca vats, at the Natividad mine, Oaxaca, Mexico.

Electroplating Battery Plates.—In the *Mining and Scientific Press* for July 29, J. D. Hubbard describes the electrolytic apparatus used at the Oriental Consolidated Co.'s mines in Korea for coating amalgamation plates with silver, and discusses many practical details in connection with the use of silver-coated plates.

Parting Bullion.—The *Brass World* for June describes a method for parting platinum-gold-silver bullion.

Reid's Method of Smelting.—The *Mining and Engineering World* (Chicago) for July 1 has an article on the electric smelting furnace patented by J. H. Reid of Philadelphia. It is stated to be applicable to the treatment of complex sulphides containing precious metals. The process has been much advertised but the technical details are incomplete.

Roasting Nickel-Copper Matte. — The Columbia *School of Mines Quarterly* for July contains a paper by E. F. Kern and H. W. Walter describing investigations made in the metallurgical laboratory of the School of Mines with a view of obtaining information as to the chemical reactions involved in the process of roasting nickel-copper matte. This is a branch of metallurgy that is kept secret by the smelters.

Horwood's Sulphatizing Process. — In the June *Proceedings* of the Australasian Institute of Mining Engineers, E. J. Horwood describes the possible applications of his process for sulphatizing the galena and oxidizing the pyrite constituents of complex sulphide slime, leaving the blende unaltered. By this method the slime may be treated by flotation and the blende recovered. Donald Clark described this process in our issue of January 1910, and Mr. Horwood's paper gives further details of experimental results.

Copper Smelting at Lake Superior.—In the Columbia *School of Mines Quarterly* for July, Henry D. Conant gives an outline of the methods of smelting in use in the Lake Superior copper district.

Electrolytic Refining. — In *Metallurgical and Chemical Engineering* for August, E. F. Kern contributes a paper on the constitution of anode sludge and describes the various methods employed for extracting the metallic contents.

Zinc Metallurgy.—The *Mining and Engineering World* (Chicago) for August 12 contains a description of the Louvrier-Louis furnace for distilling zinc ores. This furnace has been used in France and Spain in connection with steel, ferro-silicon, and calcium carbide, and has only recently been applied experimentally to zinc ores.

Roasting Furnaces.—In *Revue de Metallurgie* for August, Leon Guillet contributes a lengthy article reviewing recent progress in the roasting of sulphide ores.

Determination of Copper by Iodide Method.—In the *Mining and Scientific Press* for July 8, L. D. McClure describes his method of carrying out the iodide determination of copper in ores, that he has used for some time on the samples at the Live Oak property, Arizona. He finds it more rapid than the permanganate and electrolytic methods, and dependable within narrow limits of error.

Analysis of Tungsten Ores.—In *Metallurgical and Chemical Engineering* for August, Hugh F. Watts reviews several methods of analysing tungsten ores.

Cost of Producing Oil.—In the *Mining and Scientific Press* for July 8, W. R. Jewell discusses the various factors in the cost of producing oil.

Transvaal Coal.—At the June meeting of the Chemical, Metallurgical, and Mining Society of South Africa, M. Thornton Murray read a paper describing his tests of the calorific value of Transvaal coals.

Earthquakes in Mines.—The *Quarterly Bulletin* of the Canadian Mining Institute for April contains a paper by James Douglas giving reminiscences of the effects of earthquakes in mines. He is installing seismographs in the copper mines with which he is connected in Arizona with the object of studying earthquake effects at depth.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be supplied on application to The Mining Magazine.

BOOKS REVIEWED

METALLURGY OF TIN. By Henry Louis. Cloth, octavo, 140 pages, with many illustrations. New York: McGraw-Hill Book Co. Price 8s. 6d. For sale by *The Mining Magazine*.

Of all branches of metallurgy the smelting of tin ores is at the present time the most secret. Those who by labour and experience have mastered the intricacies of the art are still able to adhere to the ancient order of things and keep their knowledge to themselves. The terms and conditions on which tin ores are bought and sold are sufficiently favourable to the mine-owners to make it not worth their while to re-invent the metallurgy for themselves. There are no gold and silver contents in tin ore and concentrate to provide the smelters with inordinate profits, as was the case in the palmy days of the Swansea copper business. Though sellers of tin ores grumble occasionally at the alleged onerous terms of the smelters, their grievance is comparatively small. After all, why should a buyer possessing special technical knowledge which is his stock-in-trade and goodwill, tell the seller how to do it himself? If an American company possessed a tin mine in Dakotah or Durango, having a yearly output of a million tons of 6% ore and smelted it on the spot, we should in no time have a generous literature on the metallurgy of the metal; but not till then. At present the smelters in the Straits, Queensland, Cornwall, and Hamburg alone have the knowledge how to combat the affinity of tin for silica, and how to deal with the multitudinous impurities usually found in association, such as iron, wolfram, titanium, etc. The straight tin-smelting reaction is simple enough, and if ore and labour is plentiful a crude furnace and process will be profitable though much metal is lost in the slag. Such operations are conducted in China, the Malay peninsula, and in South America, but they cannot be ranked as metallurgy in its modern meaning, nor are they of great help to the student who desires to equip himself for a practical campaign.

It stands to reason that any book on the metallurgy of tin must be (to quote the stereotyped newspaper proverb) like the play of Hamlet with the part of the Prince of Denmark omitted. Mr. Louis has done the best he can with the means at his disposal. Though not having experience in modern works, he spent some years of his earlier life in the Malay peninsula and studied the native methods of treating the ores, so that his book has parts of personal interest. He has also collected together nearly every available item of published information. The greater part of the book originally appeared as a chapter of 'The Mineral Industry,' Vol. 5, published in 1897, and this volume was in demand after the other contents had lost their general interest. Mr. Louis was therefore induced to reprint the article in book form, with as much additional matter as possible. The work is by no means authoritative; naturally, owing to the lack of first-hand information except from Malaya, this cannot be expected. There are indeed many parts where additional or corroborative information is desirable, and could be given by people with special knowledge without any detriment to their own interests. For instance, the statement that the Bolivian concentrates smelted in Cornwall are richer than those produced locally is open to question. The author is inaccurate in his names; "Levey" and "Nicholaus" may be pardonable, but it is disconcerting to find the chief German smelting firm given as "Robinson & Bense" and our good friend George T. masquerading as "M. J. T. Holloway."

METALLURGIE DES ZINNS. By Hans Mennicke. Octavo, 196 pages, and 40 illustrations. Halle, Germany: Wilhelm Knapp. Price 10 marks.

This book is one of a series of monographs on applied electro-chemistry issued by the publishing house of Knapp of Halle. As we have already said in reviewing Mr. Louis' book, the literature relating to the metallurgy of tin is scanty. The present book does not tell us quite as much as some others. On the other hand it describes in detail many of the side subjects, and the parts dealing with the recovery of tin from scrap, dross, and other waste material contain plenty of useful information. The chapter on the refining of low quality tin by chemical and electrolytic methods is also good.

TECHNICAL DICTIONARY IN SIX LANGUAGES. Edited by Deinhardt and Schlomann Vol. XI, Metallurgy of Iron; compiled by William Venator and Colin Ross. Cloth, 800 pages, illustrated. Munich: R. Oldenbourg; London: Constable & Co. Price 10s. 6d. For sale by *The Mining Magazine*.

We have already reviewed several volumes of this series of technological dictionaries which covers the German, English, French, Russian, Italian, and Spanish languages. Nobody appreciates the enormous difficulty of producing a dictionary of this sort until he has tried to do it, so criticism should be kindly. These books are essentially German, and the words or phrases in the other languages are not always indigenous, but are often the literal translation of the technical German. For instance, the German chemist has a word 'chlorentwicklungs flasche,' which means a glass apparatus used in producing chlorine for laboratory purposes; the dictionary calls it a "chlorine developing apparatus." Englishmen are often taunted with their lack of enterprise as regards the study of foreign languages, and are told that for every Englishman that learns German there are a hundred or even more Germans that learn English. On glancing through the wonderful words such as 'Kapselhochdruckgeblase,' 'umfanggesschwindigkeit,' and 'gaszufuhrungskapilare,' we cannot help thinking that the inclination or otherwise to learn each language is an exhibition of common sense on the part of both nations.

The present volume covers the metallurgy of iron and a number of cognate subjects. The bulk of the book is occupied by words and phrases connected with the foundry, blast-furnace practice, and the manufacture of wrought-iron and steel. Over 100 pages are occupied with laboratory work and metallography. Other chapters are devoted to machinery used in these industries, fuel, fluxes, the dressing of iron ores, ore deposits, and minerals. The elucidation of the meaning of the words is helped by little diagrammatical drawings which often serve as useful indicators.

MINING LAW FOR THE PROSPECTOR, MINER, AND ENGINEER. By H. W. MacFarren. Limp cloth, small octavo; 356 pages, with illustrations. San Francisco: *Mining and Scientific Press;* London: *The Mining Magazine*. Price 8s. 6d.

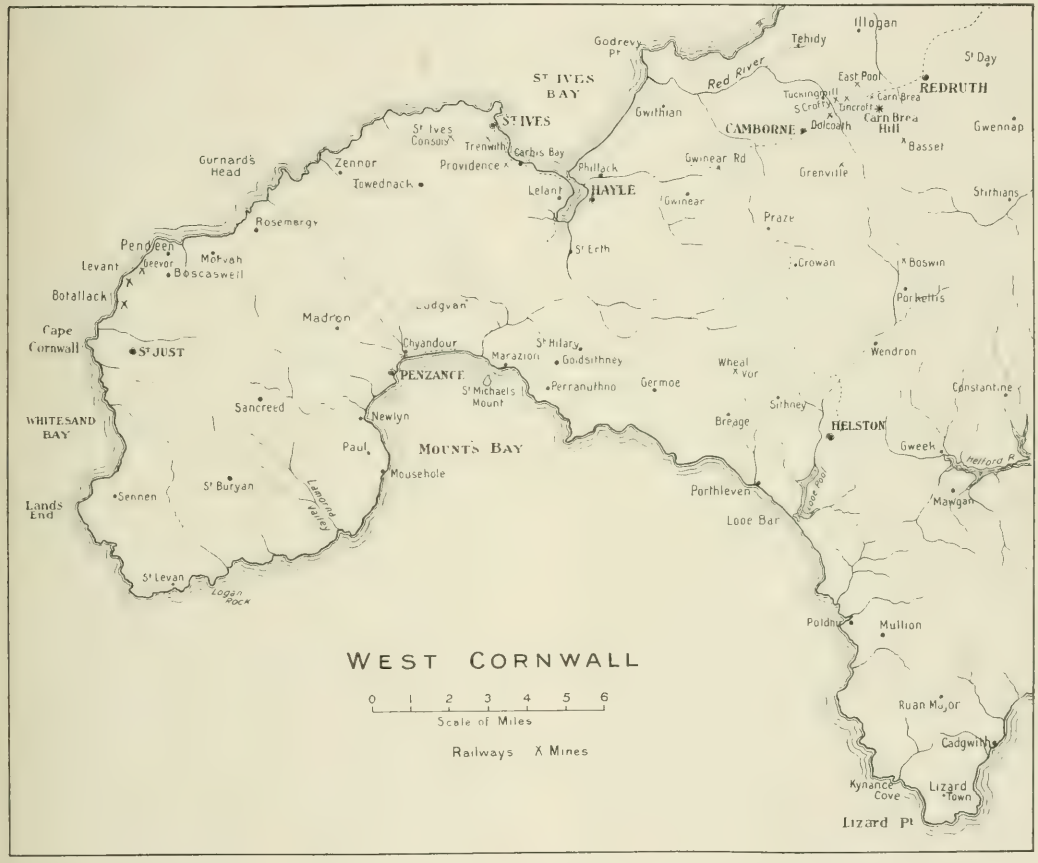
This book as its title indicates is intended for the practical miner, and not for the lawyer who is already supplied with a number of works adapted to his particular requirements. Mr. MacFarren's book should be of great value in the United States as it fills a want that has been long felt.

MINERAL RESOURCES OF WYOMING. By C. E. Jamison, State Geologist. Pamphlet, 102 pages. Cheyenne, Wyoming: S. A. Bristol Co.

This is a bulletin published by the State of Wyoming and is useful because it contains the mining laws of that State.

COMPANY REPORTS

Dolcoath.—The elasticity of the premier tin mine of Cornwall is once more evidenced by the report for the half-year ended June 30 now issued. The underground work in connection with the new Williams shaft, and the substitution of Holman air-cushion or ' pneumatic ' stamps for the battery of old Cornish stamps, have made it necessary to reduce the amount of ore mined and milled. To make up the deficiency, it has been possible to raise ore of higher grade, and this fact, together with the advance in the price of tin, has had the result of bringing the total receipts to a substantially higher figure. The same policy was pursued during the second half of 1910, but not to the same extent. The tonnage raised and milled was 40,315, compared with 44,659 during the second half of 1910, and 47,279 during the first half of 1910. The concentrate sold was 852 tons, compared with 877 tons and 852 tons, and the recovery was 47·38 lb. per ton, compared with 44 lb. and 40·4 lb. The average price realized per ton was £117. 6s. 6d., compared with £97. 15s. 2d. and £88. 13s. 8d., and the receipts were £100,048, compared with £85,819 and £75,639. The profit, after payment of royalty, was £36,370, compared with £24,515 and £13,018. The working costs were not substantially different. The shareholders have received £34,000 as dividend, being at the rate of 10% for the half-year. The new battery of 8 air-cushion stamps is at work, and a further four are to be erected. The cage roads are completed at the Williams shaft, and the electric hoisting engines and the electric pumps are being erected. It is expected that the shaft will be ready for operation by the end of September. An interesting item in the report is the announcement that the zinc-copper and copper-tin deposits in the Killas Shaft and Stray Park sections are being actively explored once more. Some years ago a flotation plant was erected for the treatment of these ores, but it was not worked regularly, owing to lack of labour required for the development of the deposits. The directors are offering the remaining 10,000 shares *pro rata* among shareholders at par, £1 ; they have already received an offer for the whole or any part of the issue. At the shareholders meeting Mr. Thomas said that recent developments at depth had disclosed important bodies of ore.



Wheal Vor.—This old tin mine is situated in the Breage district of Cornwall, a few miles south of Hayle It was reopened in 1906 by the Dolcoath group, but misfortune has dogged the steps of the enterprise. The electric pumps first supplied were of faulty construction, and the engines driving those substituted, after having unwatered the mine to 864 ft. below adit, broke down. Enough exploratory work, however, was done in the interval to prove that there are several veins worth following. Owing to the difficulty of raising further funds the mine has been idle for a year. In the report of the company for the year ended April 30, now issued, the directors speak more hopefully

of the prospects of another unwatering and reopening. They point to the fact that electric power can be obtained cheaply from the new central electric station at Hayle, which is supplying Dolcoath and South Crofty, and will shortly send current to Geevor at Pendeen. By taking advantage of this opportunity cheap power could be obtained with little outlay of capital. The directors are intending to call shareholders together before long in order to discuss the possibility of raising the necessary money. Frank Harvey, J. M. Holman, and Gilbert Pearce have resigned from the board, and James Wickett and C. V. Thomas have taken their place.

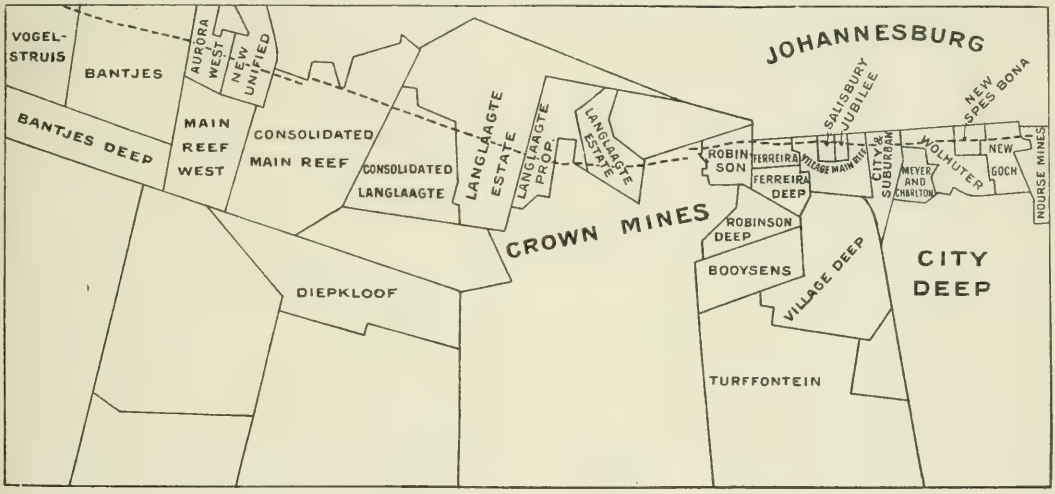
Carn Brea & Tincroft.—The report for the half-year ended June 30 of this Cornish company shows that the yield per ton has fallen seriously, being only 22·29 lb. of tin concentrate per ton of ore stamped. Since the present company was formed in 1900 only once, namely, during the second half of 1903, has the figure sunk below 23 lb., and the average has been from 26 to 30 lb. The ore raised was 38,253 tons and the produce of tin concentrate 380 tons, as compared with 38,892 tons and 472 tons during the previous half-year. The best results were obtained during the first half of 1909 when 36,825 tons yielded 567 tons of concentrate. The income from the sale of tin concentrate was £39,038, figures practically identical with those of the two other periods quoted above, the price of tin being the compensating factor. During the past year the average price obtained for the concentrate was £102 as compared with £82 during the second half of 1910 and £69 during the first half of £1909. The sale of wolfram, copper, and arsenic ores and concentrates brought the total receipts to £41,057. The working cost was £41,192, figures slightly higher than the average of the last four years, To this has to be added £1501 for royalties, so that the result of the half-year's work is a loss of £1936. No allowance is made for depreciation. The current history of the company has been given in our correspondence pages at intervals during the present year and we have recorded the appointment of Edward S. King, late of West Australia, to the managership. In his report he foreshadows new methods of payment for underground contract work, improvements in the handling of ore, and the overhauling of the old dressing-plant. He adds: "At present there are 8 hauling shafts and 5 pump shafts, and altogether 24 engines working under steam, and one engine on suction gas," a serious item in the standing charges. As regards the Humboldt magnetic separator recently provided for the removal of wolfram, he reports that it is giving entire satisfaction.

Grenville United.—This company was formed under the limited liability laws in July 1906 to acquire the Grenville tin mine to the south of Camborne, Cornwall, that had previously been worked for many years on the cost-book system. The ore yields a good quality concentrate, fairly free from wolfram and iron, and bringing a higher price at the tin ticketings than the produce of many of the neighbouring mines. In writing of the company in our March issue, we mentioned that the new manager, Henry Battens, has introduced the wholesome practice of buying supplies in the open market instead of being dependent on directors or shareholders interested in the timber, machinery, and other trades. At the same time we recorded that he had made a profit of £4308 for the half-year ended December 31 last, so reducing the debit balance from £10,465 to £6157. The report now issued covers the first six months of 1911 and shows that in spite of the continued water trouble the debit balance has been changed into a credit balance of £799. The amount of ore raised was 17,059 tons and the yield of concentrate was 266 tons, as compared with 21,047 tons and 298 tons during the second half of 1910. The extraction was 35 lb. per ton as compared with 32¾ lb. The income from sales was £30,293 as compared with £29,485, and the profit after paying royalty was £6956 as compared with £4308. The output has been smaller than would have otherwise been the case, because for at least half the time the water prevented access to the best stopes. It will be remembered that last autumn was unusually wet and the pumps were unequal to the extra duty imposed. Much time and money were spent in repairing and strengthening the pumps, and afterward, when the water was lowered, in inspecting and strengthening the various workings. A profitable and promising shoot of ore has been found in the 320 fm. level east of Fortescue's shaft and a level is being driven at 355 fm. west of the same shaft to intersect a shoot that has yielded much ore in the level above. Mr. Battens writes hopefully of the future.

St. Ives Consolidated.—This company was formed by the Schiff-Dietzsch group in June 1908 to acquire from the parent company, the National Minerals Corporation, a number of leases of old tin and uranium mines in the neighbourhood of St. Ives, Cornwall. This group started work in Cornwall at the Hingston and Clitters mines near Tavistock eleven years ago, and have since then reopened old mines near Truro, and acquired the West Kitty and other properties in the St. Agnes district. No profits have as yet been earned by any of the ventures. The work in the St. Ives district has been centred on the Trenwith mine, which yields pitchblende, and on the Giew tin mine. The report for the year 1910 states that the Trenwith has been unwatered and that a subsidiary company, the British Radium Corporation, is extracting uranium and radium compounds at the laboratory at Limehouse, London, under the scientific direction of Sir William Ramsay. Up to the end of 1910 the income from the sale of the products was £1025, and since then a further £9073 has been received, while orders valued at £4300 are in course of execution. The report does not say how much of the products are radium and uranium compounds respectively. At the Giew tin mine unwatering was at first undertaken with a Cornish pump, but subsequently an electrical installation was provided. The electric generating station contains Diesel oil engines. Twenty stamps and a concentrating plant have been erected, and they started work at the beginning of 1911, chiefly on dump material. Up to June 19 the amount of tin concentrate sold to the smelters was 25 tons. Additional leases have been acquired, including the Trink Hill, and an old dump, which latter is estimated to contain sufficient tin to warrant the erection of another 20 stamps. At the Giew mine the water has been lowered to 480 ft. below adit, or about half the depth of the former workings. A vast amount of work has been done in clearing old adits and shafts and putting them in order, and the report of Ferdinand Dietzsch, the engineer, gives details on this point. It is not possible however to obtain from the report any idea of the ore reserves or of the prospects of the mines as producers of profitable ore. The directors announce that they are intending to start a radium spa at St. Ives. The balance-sheet shows that the capital of the company is £220,000, of which £80,000 is in cumulative 6% preference shares and £140,000 is in ordinary shares, the latter being the purchase price paid to the National Minerals Corporation for the leases. The expenditure during the period

from October 1, 1909, to December 31, 1910, was £70,850, of which £44,954 was on plant, machinery, buildings, and surface works, and £13,555 on development. There is a liability of £23,850 for money advanced by the National Minerals Corporation. Judging by the balance sheet it would appear that further working capital will be required, as the balance of cash in hand is small.

Weardale Lead.—This company has been working a group of lead mines in Durham county since 1883. The district in which they are situated is in the high country, consisting of carboniferous limestone, at the junction of the counties of Cumberland, Northumberland and Durham. The Alston and Nenthead lead and zinc mines are not far away. The report for the twelve months ended June 30 shows that 3129 tons of ore and concentrate was smelted yielding 2664 tons lead. This compares with 4199 tons yielding 3402 tons lead during the previous year. The decrease is



PART OF WITWATERSRAND, SHOWING POSITION OF ROBINSON DEEP.

only temporary and is entirely due to the fact that much development work has been done at the Boltsburn mine. The income from the sale of lead was £33,421, and from the sale of 16,464 tons of fluorspar £7514. Most of the lead ore came from the Boltsburn mine and of the fluorspar from the Stanhopeburn mine. The profit for the year was £6473 out of which £4896 was paid as dividend, being at the rate of 5%. A year ago the dividend was 10%. We note that Errington Thompson, who did much good work for the company, resigned the position of manager at the end of 1910 and has been succeeded by H. S. Willis.

Robinson Deep.—This mine is a second deep in the central part of the Rand, being on the dip of the Robinson Central Deep (now absorbed in the Crown Mines) and the Ferreira Deep. It is controlled by the Consolidated Gold Fields and is isolated from others of the same group, being entirely surrounded by Wernher-Beit-Eckstein properties. Milling commenced in 1898 with 40 stamps, and the equipment now consists of 300 stamps and 5 tube-mills. The report for the year ended March 31 shows that scarcity of labour has greatly interfered with operations below and above ground and the average of stamps running was only 218. The tonnage of ore hoisted was 629,792 tons, and after the removal of 15% waste, 533,850 tons went to the battery. By amalgamation 103,654 oz. was extracted below the stamps and 36,481 oz. below the tube-mills. The cyanide plant extracted 45,837 oz. from sand and 14,206 oz. from slime. The total yield was 200,178 oz. valued at £838,570, an extraction of 7½ dwt. or 31s. 5d. per ton milled. The working cost was £505,229 or 18s. 11d. per ton, leaving a profit of £334,379 or 12s. 6d. per ton. The manager, J. J. Wessels, has done much in the way of introducing stoping drills and he gives interesting information in the report now published. Our Johannesburg correspondent quoted his report in full, and made comment, in our August issue. As regards ore reserve, it was estimated on March 31 that 1,140,000 milling tons averaging 7·2 dwt. was ready for stoping, and in addition 86,000 tons averaging 6·65 dwt. was reckoned as partly developed but not ready for stoping.

Oroya Leonesa.—This was one of the three companies formed in 1910 to acquire the assets of the Oroya Brownhill of Kalgoorlie when the latter company was dissolved on the exhaustion of the mine. The particular asset acquired was the Leonesa gold mine which is situated near Matagalpa, Nicaragua. H. C. Hoover is chairman of the company, Bewick, Moreing & Co. are general managers, James Brothers are consulting engineers, and J. Semmens Allen is mine superintendent. The report now issued covers the period from the formation of the company to March 31. It shows that operations have been greatly hindered by the Nicaraguan revolution. The plant consisting of 20 stamps and cyanide equipment has been delivered and part of it has been erected.

Central Chile Copper.—This company was formed in 1894 to continue the work of the Panulcillo Copper Co. that was originally started in 1864. The issued capital is £312,468, and small dividends have been paid in 1896, 1900, 1901 and 1907. The old Panulcillo company paid dividends during three short runs of years, but on the whole was not a profitable proposition. A large proportion of the shares of the present company are held in France. Eugene A. J. Goldschmid is chairman, B. C. Hinman is managing director, and H. M. McLaughlin is manager. The business of the company has been hindered during the last two years owing to the low price of copper; not only are the profits derived from the company's own ores reduced, but many of the mines from which supplies of custom ores are usually obtained have been closed. Another adverse circumstance is the

fact that the ore raised from the company's mines is of lower grade than formerly The report now issued covers the year 1910. During that time 28,405 metric tons of the company's ore was smelted, together with 19,872 tons of purchased ores. The content of the company's ore was 3·22% copper and of the purchased ores 7·92%; these figures compare with 3·6% and 7·72% the year before. The production was matte containing 2128 tons copper, and gold and silver worth £10,373, as compared with 2144 tons and £8485. The result of the year's operations was a loss of £1263 which brings the debit balance to £7953. The report states that the development work at various properties of the group continues to disclose ore but not in the quantity or of the quality desired. Improvements are being made in the smelting plant with a view of reducing costs.

Mount Morgan.—The 26th annual report of this gold-copper mine in Queensland for the year ended May 31 shows that the production of gold was smaller than during the previous twelve months, while the output of copper was practically the same. No gold is now extracted from oxidized ore, and the year's work is credited with only an unimportant amount obtained at the final clean-up; the extraction from the sulphide by chlorination and in the blast-furnace has decreased for reasons explained later. G. A. Richard, the manager, in his report, shows that during the year 173,209 tons of Mount Morgan ore was smelted, yielding 5222 tons copper and 89,473 oz. gold. Mixed with this was 52,289 tons of Many Peaks ore, now used as flux, from which was produced 1186 tons copper and 479 oz. gold. By chlorination 109,371 tons of sulphide ore yielded 51,210 oz. gold and 565 tons of copper, and 1287 oz. gold was obtained by the final clean-up of the oxidized-ore plant. The total production was therefore 6973 tons copper and 142,449 oz. gold, compared with 7062 tons copper and 187,867 oz. gold the year before. The decrease in the output of gold is due to the considerably smaller amount of both classes of ore treated; on the other hand the contents of both copper and gold were slightly higher. It is not now possible to mine so much chlorinating sulphide from the open-cut, as the workings are deep and the amount of overburden to be removed is so great as to make this class of operation unprofitable. As regards the decrease in the output of smelting ore, this is due to the fact that only three furnaces have been running for most of the time owing to the non-delivery of labour-saving devices. It will be remembered that the Mount Morgan has suffered from labour troubles and the wages have been substantially increased; consequently it has been necessary to take steps by the provision of machinery to cut down the number of employees. During the period of transition it has been difficult to keep together an efficient staff of workmen. No prospecting or development has been done during the year; instead, much work has been done for the improvement of ventilation and in preparation for the stope-filling system recently inaugurated. The ore reserve is estimated at 1,543,000 tons averaging 3½% copper and 8 dwt. gold and 2,070,500 tons averaging 3% copper and 2½ dwt. gold. The directors do not state how much of the copper produced was sold, but they report that the average price received was £58. 4s. 7d. or £2 less than during the previous year. Apparently the amount would be about 6060 tons. The total revenue was £953,292 and the expenditure including taxes £759,316. The directors have written off £57,413 for depreciation. As £61,727 was brought forward from the previous year it has been possible to distribute £200,000 as dividend during the year.

TRADE NOTES

Most of the trade publications mentioned in this column are available for distribution and the manager of "The Mining Magazine" will be pleased to secure copies for persons interested.

Holman Bros., Ltd. are mailing a circular relating to compressors which they have in stock for immediate delivery.

Wm. Geipel & Co. send us a description of the Vulcan reducing valve, which is designed to eliminate the weight and springs on the one hand, and india-rubber diaphragms used in other valves.

W. & T. George, Ltd. have issued a circular describing their improved theodolite which sells for £3. 10s., and while not intended for use on work requiring great care and accuracy, is practical and sufficiently accurate for small land-surveys. It should appeal to students desiring practice in surveying.

The Union Iron Works Company of San Francisco have purchased the business and good-will of the Risdon Iron & Locomotive Works, and will continue to manufacture the mining and dredging machinery for which the Risdon Co. have been well known for many years.

New York Engineering Co. have issued a new 36-page descriptive pamphlet on the Empire drill. It is well illustrated and printed. We are informed that the demand for this drill has increased to such an extent that the company has been justified in keeping a stock on hand for immediate delivery, not only at New York, but at all the principal mining centres. The catalogue is also printed in Russian.

The Oil Well Engineering Co. have just issued a 257-page catalogue and price list, illustrating and describing Well Drilling machinery and accessories. The preface gives a brief outline of the progress in the design of this class of tool from the exploitation of the Pennsylvania fields in 1859. The catalogue gives all the information necessary to the purchaser.

The Sullivan Machinery Co. issue a quarterly bulletin. The August issue (36 pages) has just come to hand, and contains the following: A New Shaft Record; Mining Coal at Collinsville, Illinois; Hammer Drilling at the Ray; Damming the Mississippi; A Difficult Feature of Diamond Drilling; Government Drilling in Nova Scotia; Quarrying with Hammer Drills; Long Column Arms in Tunnels. The articles are well edited and illustrated. The bulletin accomplishes its purpose of supplying news to those interested in the application of labour-saving devices in economically breaking and handling ore and stone.

We acknowledge having received the following trade bulletins and catalogues:

Joshua Hendy Iron Works; Bulletin No. 119 Stamp Mills, No. 120 Stamp Milling Machinery Accessories, No. 121 Rock and Ore Crushing Machinery, No. 122 Hydraulic Giants.

Wm. Powell & Co.; Catalogue No. 10, 300 pages, 5 by 8 in.; booklet on valves and other engineering specialities.

Frenier & Son; 12-page folder, 8½ by 4 in., describing the Frenier spiral pump.

Deister Concentrator Co.; pamphlets describing the No. 2 and No. 3 concentrators.

Lufkin Rule Co.; 96-page booklet, 9 by 6 in., fully describing measuring tapes and rules, with prices.

Marion Steam Shovel Co.; 9 by 6 in. flexible leather-covered book describing steam shovels; also similar book on dipper and elevator dredges, and a 10½ by 7½ in. catalogue giving details of the Marion elevator dredges for gold and tin.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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REVIEW OF MINING

INTRODUCTORY.—A month ago we looked forward to the end of the political crisis arising from international competition in Morocco, and we anticipated a revival of share speculation on the signing of the treaty between France and Germany. That event is still in the near future but it seems so well assured as to have been discounted by the stock-exchanges. Before it ceases to be a perturbing factor another centre of unrest has been created. The Moroccan imbroglio is followed by the Tripolitan highbindery with its menace of a recrudescence of the Near East question by the undermining of Turkish power in the Balkans. However, the danger is so obvious as to call for a speedy effort to check it, and we expect that the meekness with which the Turks have met the Italian demands presages an early pacification in the Mediterranean. Then, if American political activity does not interfere too greatly with the course of business on the other side of the Atlantic, we may reasonably expect a period of renewed optimism.

The last four weeks have given ample proof that the mining market has reached a level at which real holders have ceased to be sellers. Speculative holdings have been reduced to an abnormal degree. Intrinsic values begin to compare favourably with market quotations. All weak positions have been forcibly liquidated and the Stock Exchange itself, by reason of continual political disturbances, and as a measure of precaution, is rather on the bear track. How otherwise could it be explained that the actual declaration of war between two European powers has had no depressing effect on prices; on the contrary, it leaves the market looking stronger and somewhat higher all round. The public appears to have awakened to the undeniable fact, as remarked in our last issue, that mining shares dealing with properties producing gold and other precious metals, and spread all over the world, outside the possibility of political disturbances, are immune from a European conflagration. If that be the case a new era may have started for this much abused department of the Stock Exchange. Strange to say the very people who are the most ready to heap abuse on the mining houses are largely responsible for the losses they lament. At a time like the present they will steadfastly refuse to buy a single share. They want to be led like sheep, and will only listen to advice when the value of shares has already appreciated by 50% to 100%. Let the investor and speculator study the reports from the mines when markets are dull and they will have less cause to regret their share-dealings. Revenue will then be in some proportion to the price paid. During a period of prolonged depression, such as the present, the big houses cannot help making money. They buy in times of political disturbance, as now, when they would much sooner keep their cash than accumulate scrip, and they sell when everybody is clamouring for shares at inflated prices. We believe therefore that a careful selection of good dividend-payers, and of such stock as by the nature of developments allows a favourable forecast for the future, is going to benefit those who buy now.

Turning to the different departments of the mining market, we find that there is a constant stream of buying orders from the Cape. Speculators in Europe are scared and those on the spot appreciate the fact. The industry itself is sound and the resident population is investing in enterprises with the development of which they are familiar. The East Rand trouble is largely discounted in the present price, although it is gradually becoming

apparent that the root of the trouble is the fact that the Company has been crushing ore above its average grade. The commission, which has been appointed by the Company in accordance with the new mining law, may be able to throw light on the affair, but its findings are likely to prove belated. It would, however, be fallacious to draw the conclusion that the whole industry is being conducted in an unbusinesslike fashion. On the contrary, we are inclined to believe that this disclosure will put the fear of the Lord into the heart of those controlling mining operations.

The Rhodesian market, which recently exhibited a strong undercurrent, has also suffered; but a return of public confidence will not be hastened by the obvious efforts to create a boom. Chartered were a strong spot. Apart from its mineral resources the country offers big possibilities in agriculture, as explained by Mr. Percy J. Inskipp, the head of this department of the Chartered Company, who has just returned from a long sojourn in Rhodesia. Other shares prominent in the public eye were Cam & Motor and Shamva. The West African market had a good appearance until the Tripolitan trouble turned the scale, but shares like Prestea, Taquah, Abosso, and a few smaller concerns, have attracted attention. We refer to the Prestea again on another page. Among Australians, Great Fingall was in quiet demand. The developments on the 17th and 18th levels so far bear out the favourable geological opinion on which the scheme of exploratory work is based. A sharp upward movement has affected Waihi Grand Junction, where excellent developments in depth are reported. Copper shares are entirely under the influence of New York fluctuations, but at the time of writing they have a firm appearance, as the copper statistics continue favourable. Russian securities were subjected to heavy liquidation from Paris and it looks as if they were for the present under a cloud. Oil shares continue dull.

TRANSVAAL. — The statistics for August showed a further increase in gold production, a new record of 713,407 ounces, worth £3,030,360, being made for the month. For eight months the total yield is £22,932,713, as against £31,995,266 for the 12 months of last year. Owing to the East Rand Proprietary's trouble, the averages for August were spoiled, the yield being 26s. 8d. per ton, on the 2,107,809 tons treated, as against 27s. 2d. in July. The cost was one penny less at 17s. 9d.; hence the resulting profit was 5 pence less, at 8s. 11d. per ton. The total profit was £967,457 as against £969,687 in July. In August 1910 the yield was 28s. 3d., the cost 17s. 8d., and the profit 10s. 6d. per ton. As regards labour the official returns show a decrease of 1772 natives on the gold mines, bringing the total to 179,810, as compared with 180,831 at the same date a year ago. The decrease has been continuous since April. In a recent speech before the Chamber of Mines at Johannesburg, the chairman, Mr. H. O'K. Webber, said that the gold mines had 67·4% of their complement of labour as against 76·3% at the same date last year. He predicted an early increase, the seasonal migration being nearly at an end. Owing to competitive recruiting among the groups and excessive fees paid to the recruiting agents by two of the groups, it is likely that drastic action may be taken by the others. It is reported that the Government has been asked to undertake the recruiting, as being a partner with the mining companies and a beneficiary from their successful operations; but it is unlikely that the Government will saddle itself with the disagreeable task.

A later telegram from Johannesburg states that the supply of native labour decreased during September by 145, as compared with an increase of 1369 in the corresponding month last year. This is a distinct disappointment, as a turn in the tide of Kaffir migration is expected at this season. An influx

of 20,000 'boys' is said to be due from the northern districts during the next three months.

The directors of the Transvaal Gold Mining Estates are to be complimented on the frank statement issued by them on September 30. It appears that the concession under which they hold one of their claims at Pilgrim's Rest expires on May 5, 1913. Hence it is necessary to extract more ore from the mine on this claim than from their other workings, and as this ore is lower in grade than the average of the group, the yield in the mill will suffer until the tonnage can be increased proportionately.

On October 2 the Modderfontein B mill started crushing and a declaration of output may be expected next month. At the New Modderfontein the Merrill precipitation-press is being used, as at the Brakpan. At the Village Deep a trial is being made with the Hardinge tube-mill. At the City Deep the Nissen stamp is to be installed.

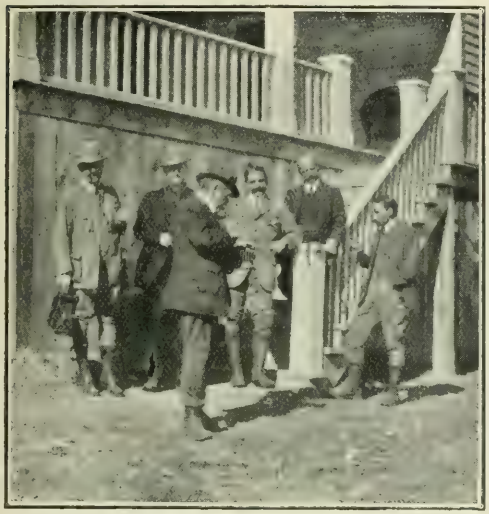
RHODESIA.—A new record was made in August, the output of gold being 57,890 ounces, worth £243,712, which compares with £237,517 in July and £191,423 in the corresponding month of last year. The production for the eight months of the current year is £57,943 more than it was during the corresponding portion of 1910. The Globe & Phœnix yielded £44,974 from 16,886 tons; this is less than in July and about the same as in June. The most notable increase is at the Lonely Reef, where the yield is £13,906 from 3480 tons, as against £11,673 from 2940 tons in July. The only other gain of any consequence is made by the Thistle-Etna, the output being £4726 from 3100 tons, as against 4195 from 2600 tons in July.

A cablegram announcing a slackening of production, owing to insufficiency of labour, depressed shareholders in Globe & Phœnix. The half-yearly report issued recently is fairly satisfactory. Details concerning the workings indicate the irregular distribution of the rich ore. Metallurgical progress is noteworthy, the treatment of the antimonial gold ore having been solved by Mr. H. T. Brett, as described by him in our July issue. Additional roasting plant is to be provided, enabling further extraction of gold from the slime.

Copper mining in Central Africa is nearly synonymous with the Tanganyika Concessions, but we note that the Kafue Copper Development Co. is doing good work. The properties were described by Mr. Owen Letcher, in our last issue, as being situated "in the hook of the Kafue river" in Northwest Rhodesia. A report recently issued states that the ore broken in the Silver King mine is being carried to the Sable Antelope mine, where a smelter is in operation. So far 4000 tons of 40% copper ore has been mined. Smelting has been started and the first 10 days operation yielded 187 tons of matte assaying 75% copper. It is expected that the monthly output will be 300 tons of matte worth £40 per ton. This will be stored until April owing to lack of transport.

The Native Labour Association has issued figures that indicate the unsatisfactory efforts to recruit workers for the mines of Rhodesia. A decrease of 8102 is shown in the number of natives recruited during the first seven months of the current year as compared with the corresponding period of last year. Inability to increase the supply is due mainly to the labour necessities of adjoining territories, especially Nyasaland and Northwest Rhodesia, where emigration has been prevented. The position therefore is serious, and attention has been drawn to it by the confession of the Globe & Phœnix management that it is unable to keep its mill going owing to scarcity of labour. Other mines, such as the Eldorado, Selukwe Columbia, Lonely Reef, and Thistle-Etna, are believed to be hampered by the same cause. The farms are competing and the Rand is attracting natives by higher wages. It would appear therefore that a continued scarcity of labour in Rhodesia is likely.

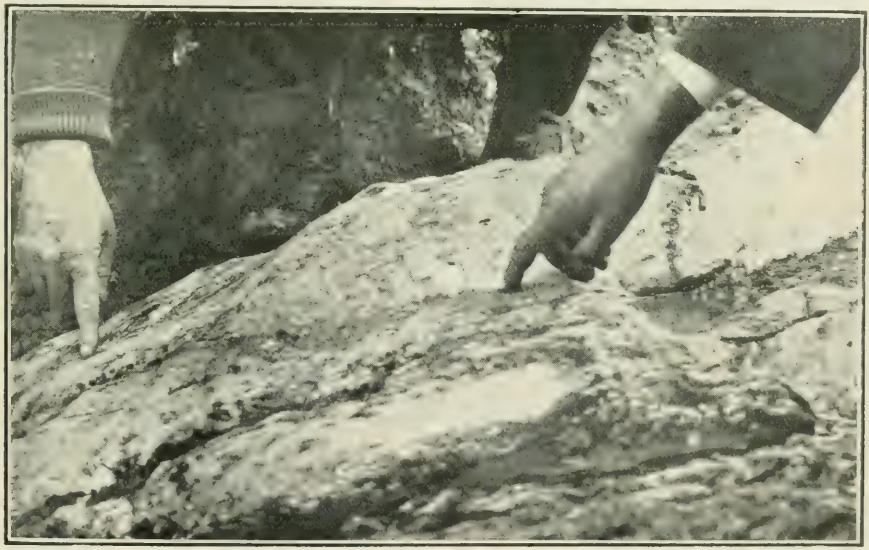
CANADA.—At Porcupine new discoveries have been made in the McIntyre and North Dome mines, and on the Dome itself, but prospecting in the northern portion of Tisdale has proved disappointing. At Swastika several



W. J. Loring, C. B. Flynn, Gerard Lovell, Ernest Williams, J. Malcolm Maclaren, and a Photographer, at Porcupine.

new finds are announced. The manager of the Hollinger is completing his sampling, with a view to an estimate, which however is not likely to be made known to the public. This may be due to the fact that the adjoining claims, belonging to the Timmins brothers (such as the Dixon and Miller - Middleton groups), are to be joined to the Hollinger, the capital for which will then be increased. A spectacular showing of ore is to be seen on the Dome property. After the fire some stripping of low-lying ground exposed a quartz vein several feet wide ; in it appears a streak two inches thick (and 18 inches long) of practically solid gold. Other smaller streaks of the same kind appear over an area of 60 by 5 feet. If the Dome had been a virgin claim this discovery would have caused a stampede.

WEST AFRICA.—For the second time a month's output of gold exceeds £100,000. In August it amounted to 25,385 ounces, valued at £103,753. This compares with £91,955 in July 1911, £57,713 in August 1910, and £100,056 in May 1909, the previous high record. For the eight months the output is now £652,032, as against £533,798 during the corresponding period a year ago, but it was



THE RICH STREAK ON THE DOME CLAIM AT PORCUPINE.

£671,703 in the first eight months of 1909. The chief feature of August was the resumption of milling at the Taquah, which gave 1771 oz. from 1443 tons. The Abosso and both of the dredging companies show gains

while the two biggest mines, the Ashanti Goldfields and the Prestea, maintain their normal monthly output of £41,000 and £21,000 respectively. Some encouraging news is published by the Wallis Syndicate, whose prospecting operations have led to the uncovering of large widths of low-grade banket. The rainy season has hindered progress, but a renewal of useful activity may be expected on the arrival of Mr. George Macfarlane, the new manager, who left London on September 27.

AUSTRALASIA.—In Western Australia the reports being issued by the Geological Survey are appreciated. C. O. Larcombe's work at Oro Banda appears to indicate a geological connection between that district and Kalgoorlie. Reports on Kalgoorlie and Southern Cross are shortly to appear. Promptitude in publication is recognized as essential to the utility of such investigations by the officers of the Survey. At Bullfinch everything is quiet. The railway so hastily constructed is working at a heavy loss. The remodelled mill of the Lake View is finished and a capacity of 18,000 tons monthly is expected. The treatment includes stage-crushing, stamps, Freeman pans, tube-mills, primary and secondary Wilfleys, followed by bromo-cyanide treatment and filter-pressing. The Star leases continue to be a valuable asset. Several breakages and accidents have hindered work at the Horse-Shoe. Experiments are being made with twenty 1250 lb. stamps crushing through a 4 by 4 screen direct to a tube-mill, followed by tables, re-grinding in pans, leaching of sand and pressing of slime. General conditions at Kalgoorlie are depressing. House property is falling in value and the future of the district generally looks gloomy.

Shareholders in the Golden Horse-Shoe have received a circular containing a lengthy and rambling cablegram from the secretary of the company. Scarcity of labour and superabundance of slides in the mine have interfered with production, so that Mr. E. Protheroe Jones thinks that the returns for this year will not reach £40,000 per month. Why the manager cannot be trusted to give such information we fail to understand. At the Ida H. the mill resumed regular work on September 1, and during the ensuing month the profit was increased nearly a thousand pounds as compared with the previous returns. The stoping-width has been reduced from over 6 feet to 5 feet, with proportionate economy, for the vein itself will average only 20 inches.

Conditions at the Great Cobar are improving. The weak point was underground, the workings not having been opened up so as to yield the proper mixture of ore required for economic smelting. This weakness was accentuated by the purchase of the Cobar gold mine, which gives a highly silicious output. The Chesney mine, which also belongs to the Great Cobar company, is developing satisfactorily, and the old concentration plant is being re-arranged with a view to eliminating the excess of silicious material in the form of slate. Mr. Nicholas Treloar, formerly at Butte, is now mine superintendent and worthily supplements the skilful metallurgical work of Mr. H. C. Bellinger. Rumours of the latter's resignation have now ceased.

A strike of miners at Mount Lyell on September 24 has compelled a complete cessation of operations at the mines and smelters in that important copper district of Tasmania. On October 2 it was announced that a further strike had ensued among engine-drivers, demanding a rate of wages recently advocated by the award of the Arbitration Court. The company's chemical works continue in operation.

The agitation in favour of an export tax on base-metal ores is not instigated by mine operators, but, by labour agitators, under the lead of the Newcastle Trades Hall, with a view to political support. Such an impost would eventually be borne by the miner and not by the foreign contractor. The cry for

Australian smelting of Australian ores is cheap; it does not reflect an economic necessity. Our correspondent sends the latest news from Broken Hill.

INDIA.—The North Anantapur company is raising further capital for the purpose of prosecuting developments, by the issue of 25,000 new shares entitled to a non-cumulative dividend of 20%. Since the formation of this company in 1908 much development has been done, but no large amount of profitable ore has been found. The lodes are so persistent and the shoots of ore so promising that the directors and shareholders are unanimous in proceeding further. The company has a sufficiently good mechanical equipment, of 20 stamps, air-compressors, etc., and no further expenditure will be required in this direction. The present monthly output is about 1400 tons, with an average content of from 6 to 8 dwt., but recent developments have disclosed ore of higher grade than this.

MEXICO.—The most important news is the peaceable choice of a new President in the person of the revolutionary leader. Foreigners in Mexico, however, are still anxious concerning the future, for it remains to be seen what support Madero can retain after he has tried vainly to please all his followers. At El Oro the new San Carlos vein in the Esperanza is opening up well; the sulphide vein of the Mexico is passing into the Nolan claim; the Exploration Company has relinquished its option on the Cometa, a claim just north of the Mexico; and the El Oro itself is maintaining its record for economic work and efficient administration.

UNITED STATES.—The wrecking of another steamer carrying mail is announced by the Alaska Mexican company, to explain a delay in the publication of its monthly output. This serves again to draw attention to the poor service given by the steamship companies on the Pacific coast of North America. It is so bad as to constitute a menace to travel in a region that is not only picturesque and interesting, but of growing industrial importance.

It is announced that the proposed merger of the Calumet & Hecla with nine other companies, in which it holds a controlling interest, has been abandoned owing to the prospect of endless litigation. The talk of a big merger which has been a cloud on the American copper industry for so long has now finally vanished in the hot air of the trust-buster. The New York copper market is dull and will continue to be so until the prevailing depression in American industry is lifted by decisive legislative action one way or the other.

SIBERIA.—The report of Mr. C. M. Rolker covering nine months' operations by the Lena Goldfields does not include details concerning the three summer months during which the major part of the production is won. Therefore the report possesses scant interest. Moreover, it may be pointed out that the revenue credited for the year ending June 30, 1911, did not include the gold won from 200,000 cubic yards remaining on the dump unwashed (as shown by the difference between the quantity hoisted and the quantity washed), but the debit did include the cost of mining and hoisting this amount of gravel. Thus his figures are apt to prove confusing. The Orsk Goldfields reports continued successful work by the stacker-scow, a little machine that has proved highly successful, pending the completion of the dredger itself, the construction of which has progressed sufficiently to permit of a trial before the winter stops operations. The stacker was described by Mr. J. P. Hutchins in our issue of November, 1910; but it is well to add that to Mr. C. W. Purington the company owes the adoption of the machine, which now includes a gold-saving appliance on a scow and a log-washer for disintegrating clay.

The Central Mining group has been investigating an important concession covering

also some gold and platinum mines, in the Ural region. Johnson, Matthey & Co. have a half interest. The examination was made by Mr. W. M. Chandler. The incident is interesting as exemplifying the wide scouting for new business on the part of a firm formerly identified with South African industry.

VARIOUS.—Gold mining in Egypt is not quite dead yet, as is shown by the operations at the Barramia mine. A return of £18,889 from 1861 tons, including a yield of £1000 worth of gold from 112 lb. of ore, at 130 feet, indicates a patchy gold distribution, but it is promising. Prospects at 250 feet are said to be encouraging.

In Chile, a discovery of gold, followed by local excitement, is announced as having been made in the department of Curepto, in the province of Putu. A later telegram from Santiago gives Constitucion as the locality and explains that a stone in the foundation of a house was found richly impregnated with gold, leading to a search for its place of origin on a neighbouring hill. In an outcrop of soft quartz a patch of rich stuff, yielding £15,000 worth of gold, was subsequently found, and a local company has been formed to start operations.

According to telegraphic despatches, a party of prospectors has found rich gold deposits in Baffin Land, a large island off the Labrador coast, on Davis Strait and opposite Greenland. It is said at St. John's, Newfoundland, that 5 tons of quartz yielded 1 oz. of gold per ton.

TIN.—The boom in Tronoh shares and the weakness in quotations, which has bothered the sort of perplexed shareholder who writes a protesting letter to the financial Press, may be explained first by the coming of the monsoon, with rain that floods the open workings, and secondly by the fact that during the absence of the manager in England the submanager extracted a rich patch kept in reserve for such a rainy day as is literally afforded by the monsoon. On October 3 a cablegram was received stating that heavy rains and a damaged dam had been followed by flooding of the mine workings. The output for September was 360 tons of tin-stone valued at £35,000 as against 446 tons, worth £50,750, in August, the profit in September being £17,200 as against £53,500 in June. On October 4 Mr. Harry D. Griffiths, the manager, who had just arrived at the mine, cabled that the workings were submerged but that they could be unwatered in 8 days. The loss of output is 150 tons, but any forecast of the future is difficult at present.

On the north-east coast of Tasmania, an important find has been made at the Banca tin mine. Drill-holes indicate the existence of several layers of rich material. By the completion of a trail 21 miles long between Zeehan and Queenstown a valuable aid has been given to prospecting in localities hitherto almost inaccessible.

OIL.—We publish a useful article on the oil industry of California. It is noteworthy that the fight started a year ago by the cancellation of agreements between the Standard Oil and Asiatic Petroleum companies is rumoured to be on the eve of settlement. At that time the Standard Oil in a circular claimed that the 70 new companies promoted in Europe had accentuated the over-production of oil, and that to balance this the Standard would reduce prices with a view to stimulating consumption. It appears now that American exports of mineral oils have increased during the year from 39,000,000 to 1,500,000,000 gallons.

At Maikop, an arrangement has been made whereby the various companies consolidate their boring operations, which will now be conducted by an association to which all will jointly contribute, under the direction of a representative committee. The shallow petroliferous sand formation has proved highly productive, but the deep drill-holes have failed to strike oil. In Australia, the British Australian Oil Co. announces the completion of its aerial haulage system and the commencement of production.

STATISTICS

Stocks of Copper in England and the Continent.
Reported by Henry R. Merton & Co.

	July 31 Tons	Aug. 31. Tons	Sept. 30 Tons
In England	53,807	52,661	52,111
In France	5,893	5,728	5,654
Afloat from Chile	2,075	1,975	2,375
Afloat from Australia	6,250	6,550	7,200
Total	68,025	66,914	67,340
In Rotterdam	7,550	7,650	7,250
In Hamburg (estimated)	10,400	10,800	11,100

American Copper Producers' Association.
In Tons of 2,240 lb.

	Production.	Deliveries: Domestic	Deliveries: Foreign	Deliveries: Total	Stocks at end of month
January 1911	51,650	18,785	23,753	42,538	63,591
February	49,030	22,553	20,139	42,692	69,929
March	58,273	29,500	26,375	55,875	72,325
April	52,716	23,396	27,736	51,132	73,909
May	56,679	28,814	27,669	56,483	74,105
June	55,605	27,525	31,902	59,427	70,283
July	50,075	25,438	33,429	58,867	61,491
August	56,024	26,757	31,185	57,942	59,573
September	51,602	25,587	22,689	48,276	62,899

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Totals, 1910	7,228,588	305,532	7,534,120	32,002,912
January 1911	625,862	25,201	651,027	2,765,386
February	585,683	24,965	610,828	2,594,634
March	649,247	26,818	676,065	2,871,740
April	638,421	29,293	667,714	2,836,267
May	658,196	27,755	685,951	2,913,734
June	657,023	27,544	684,567	2,913,734
July	679,881	29,377	709,258	3,012,738
August	682,405	31,002	713,407	3,030,360
September	669,773	30,852	700,625	2,976,065

Cost and Profit on the Rand.

Month.	Tons	Yield per ton	Costs per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
January 1911	1,865,232	26 6	17 11	10 1	930,059
February	1,712,198	28 0	18 3	10 3	874,612
March	1,960,678	28 6	17 11	9 9	949,415
April	1,926,583	27 7	17 6	10 1	971,858
May	2,002,926	27 7	17 10	9 7	956,823
June	1,986,559	27 6	17 11	9 8	960,381
July	2,095,220	27 2	17 10	9 4	969,687
August	2,107,809	26 8	17 9	8 11	967,457
Totals and averages for 1909	20,543,759	28 11	17 1	11 6	11,794,376
Ditto 1910	21,432,541	28 6	17 7	10 6	11,216,105

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31	183,268	8,357	9,991	201,616
February 28	189,434	8,513	9,814	207,761
March 31	193,457	8,493	10,061	212,011
April 30	194,328	8,511	10,272	213,111
May 31	190,392	8,379	10,425	209,196
June 30	186,940	8,212	10,597	205,749
July 31	181,582	8,122	11,054	200,758
August 31	179,810	8,182	11,292	199,284
September 30	179,619	8,045	11,475	199,139

Gold Output of India.

Year 1909	Year 1910	Sept. 1911	1911 to date
£2,083,901	£2,104,858	£181,913	£1,413,793

Production of Gold in Rhodesia.

Month.	1908	1909	1910	1911
	£	£	£	£
January	199,388	204,666	227,511	207,903
February	191,635	192,497	203,888	203,055
March	200,615	202,157	228,385	231,947
April	212,935	222,700	228,213	221,296
May	223,867	225,032	224,888	211,413
June	224,920	217,600	214,709	215,347
July	228,151	225,234	195,233	237,517
August	230,792	228,296	191,423	243,712
September	204,262	213,249	178,950	—
October	205,466	222,653	234,928	—
November	196,668	236,307	240,573	—
December	217,316	233,397	199,500	—
Totals	2,526,007	2,623,788	2,568,201	—

Production of Gold in West Africa.

Month.	1909		1910		1911	
	Oz.	Value	Oz.	Value	Oz.	Value
		£		£		£
January	22,817	91,112	17,357	70,699	15,903	66,107
February	21,403	86,210	16,976	68,469	15,179	63,081
March	23,186	93,556	17,627	71,954	16,387	67,673
April	21,491	88,071	16,363	67,069	17,237	70,880
May	25,104	100,056	16,590	68,355	24,427	96,409
June	17,340	70,561	17,194	70,988	22,555	92,174
July	17,331	70,523	15,564	58,551	22,510	91,955
August	17,766	71,614	13,921	57,713	25,385	103,753
September	18,125	72,963	11,497	47,746	—	—
October	15,957	65,813	13,341	55,046	—	—
November	17,882	73,824	14,021	57,658	—	—
December	17,570	71,332	15,042	61,737	—	—
	235,972	955,635	185,493	755,985	—	—

Production of Gold in Western Australia.

Month.	Export oz.	Mint oz.	Total oz.	Total value
				£
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
January 1911	17,463	102,035	119,498	507,592
February ,,	22,047	84,991	107,038	454,666
March ,,	12,296	93,267	105,563	448,426
April ,,	20,455	91,791	112,246	476,787
May ,,	22,076	88,952	111,028	471,615
June ,,	10,523	106,464	116,987	497,188
July ,,	15,334	97,387	112,721	478,805
August ,,	11,521	102,477	113,993	484,168
September ,,	5,011	114,615	119,626	508,135

Other Australasian Gold Production.

	1909	1910	September 1911	1911 to date
	£	£	£	£
Queensland	1,916,468	1,840,337	146,975	1,208,160
New South Wales	869,546	803,727	70,320*	503,111*
New Zealand	2,006,910	1,896,322	164,492	1,382,651
Victoria	2,897,340	2,422,700	185,164	1,590,122

* August figures only.

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
July 10, 1911	213¼	£25,019	£117 6 5
July 26, ,,	254⅝	£28,484	£111 16 3
August 8, ,,	222¼	£25,632	£115 6 8
August 21, ,,	268½	£30,109	£112 2 9
September 4, ,,	220	£25,262	£114 16 8
September 18, ,,	249¾	£27,170	£108 15 9
October 3, ,,	224¾	£25,221	£112 4 4

Exports of Tin and Ore from Straits and Bolivia.
Reported by A. Strauss & Co.

	Aug. 1911 tons	Sept. 1911 tons	1911 to date tons
Metal from Straits to Europe and America	4,675	5148	39,940
Metallic Content from Bolivia to Europe	2,308	2034	17,347

EDITORIAL

RECENT HAPPENINGS on the Rand point to the desirability of companies supported by British capital being compelled to register in London, so that shareholders may have a reasonable chance of attending the annual meetings and of exercising a healthy influence upon the policy of the directors and the actions of the management. Frankly, there has been too much *vernukerij* of late on the part of companies registered in the Transvaal. They ought to register here.

FICTITIOUS figures of production, due in part to loose estimates made necessary by leaving gold in the residual zinc of the precipitation-boxes, in the form of 'zinc shorts,' may be avoided by using a process that allows a complete clean-up after precipitation. If zinc-dust be used instead of zinc-shaving, it is possible to make an accurate clean-up, instead of leaving 10 to 30% in the precipitation-boxes.

THE AMERICAN MINING CONGRESS has postponed its annual session from September 26 to October 24. The place of meeting is Chicago, and we understand that the postponement has been made at the request of President Taft, so as to enable him to deliver an address before the Congress on October 28. A large attendance is anticipated. Undoubtedly the Mining Congress, which had a precarious existence in its youth, has steadily gained in prestige; it became an acknowledged force in public affairs when it succeeded in its advocacy of a Bureau of Mines. This new department at Washington has already, under the directorship of Mr. J. A. Holmes, done much useful work. As an annual parliament for the discussion of national mining affairs the Congress has 'made good.'

WE HAVE REFERRED previously to the careless use of the word 'tin' to designate a concentrate consisting mainly of cassiterite or tin oxide. Some of the stuff shipped from Nigeria carries only 20% metallic tin, the impurity being titaniferous ironstone, otherwise known as ilmenite. Most of the better shipments assay 65% tin and contracts with the smelters are based on that average. The bulk of the Nigerian output goes to Williams, Harvey & Co. and is treated in their works at Bootle, near Liverpool. We understand that companies operating in Nigeria can get the benefit of an exceptionally favourable contract made by the Niger Company with the tin smelters at Liverpool and Cornwall.

FRANCISCO I. MADERO was nominated president of the Mexican republic at a primary election on October 2. The general election itself is on October 15, when the choice will undoubtedly be ratified. This important event received the scantiest mention in the London Press and was uniformly confused with the general election; one paper published a portrait of the President, but it was that of another man; even our most serious newspapers had little to say. Yet the fact that the selection has been made, and made without disorder, ratifying the revolution by choosing its leader, and giving Mexico once more a constitutional government, is surely a matter of worldwide interest. General Madero is 38 years old on October 18. He has proved himself a man of ability in business, including that of a smelter. An idealist and a reformer, he devoted his large financial winnings to a campaign against the despotism of Profirio Diaz and the corrupt regime of the *cientificos*, culminating in a revolution that started on November 18, 1910, and ended by the resig-

nation of Diaz on May 25, 1911. Madero became the logical candidate for the presidency, his peaceable election being furthered by the voluntary exile of General Bernardo Reyes, a military leader who could have made trouble and for whose retirement the Mexican people owe a signal debt of gratitude. It remains to be seen whether the popular President can obtain such assistance from the better class of his countrymen as will enable him to give Mexico a stable and efficient government. We believe that he can ; we hope that he will.

GOVERNMENT COMMISSIONS of inquiry in the Transvaal suffered in public esteem by the ridiculous performance of one of these official committees of investigation in the case of the Midas Deep two years ago, when ore outside that company's boundaries and actually within an unproclaimed area was included in the supposititious reserve. We are glad therefore that the idea of a Government commission was abandoned in the case of the East Rand Proprietary. At the present time so many of the mining magnates are in politics in South Africa that it would be difficult to select a commission that would command general confidence.

IN DISCUSSING the East Rand fiasco we have said but little concerning the trouble in the cyanide annex, but it will be noted that Mr. Julian's article is highly apropos. As is well known, lime is added to the banket ore in order to neutralize any acidity due to the oxidation of pyrite and also to accelerate settlement of slime. During the recent spell of cool weather at Johannesburg it became necessary to employ more than the usual proportion of lime ; this led to the deposition of a complex hydrate of lime on the zinc-shaving, which thereby became inefficient in promoting the reaction that causes the precipitation of the gold from the enriched solution. This detrimental white precipitate is a known bugbear of cyaniders and by becoming a factor in accelerating the East Rand breakdown it will attract renewed attention.

AMONG the articles in this issue is one on the new system of stope-filling, first adopted in Silesia, but recently applied on the Rand under the direction of Mr. Edgar Pam, A.R.S.M., who is recognized as the chief authority on the subject. His description will be appreciated by mine managers in other regions. We are also fortunate in being able to give our readers a timely article on obscure losses in cyanidation by Mr. H. Forbes Julian, the joint author, with Mr. Edgar Smart, of the standard textbook on cyanide practice. The article itself has the double merit of being prepared by a specialist who also happens to be able to express himself clearly ; in other words, he has subjected his writing to a process of filtration, in which, however, a vacuum is conspicuously lacking. To us the result appears to be a clarified and enriched solution ready for prompt precipitation in the mind of the intelligent reader.

GOLD is usually described as 'fine' or 'coarse' without reference to any recognized standard. We have seen two reports on a Spanish alluvial deposit in which one engineer describes the gold as "fine" and the other as "coarse," from which it might be inferred that one of them had not seen it. We commend the subject to the standardization committee of the Institution of Mining and Metallurgy. Most men of experience will, we believe, agree in regarding particles of gold as large as No. 8 or No. 9 shot, such as is used in shooting small birds, as 'coarse' ; this size is about equal to the head of an ordinary pin ; although pins, of course, vary in this regard. Something more accurate is required for technical use. Anything coarser would be called small 'nuggets' and anything smaller would be labelled 'fine.' All

coarse gold contains some 'fine,' but truly 'fine' gold is free from 'coarse' particles. The use of the proper adjective is important not only as indicating the relative difficulty is saving the gold but also as suggesting the character of the deposit. Fine gold on the top of a placer may be due to the action of a flood and may indicate a purely superficial enrichment; on the other hand, coarse gold suggests concentration toward bedrock. From the paint gold of the Snake river, where several thousand particles are required to weigh a grain, to the nuggets of the Klondike, where one piece represents a month's wages, there is a diversity large enough to encourage discrimination.

FULL PAGE advertisements in the daily Press invite the public to find money for the New Northern Territory Explorers. Even those possessed of the least tenacious memory will recall the scandal involving an earlier enterprise having a similar name. The old company was twice reconstructed and went into voluntary liquidation in 1909. Mr. Horatio Bottomley then was, and now is, associated with the Northern Terrors, as they are called in the market. His commendation of a mining enterprise need not be taken seriously. The prospectus itself, as now issued, bears many reminders of the one that did duty in 1896. It is a bad specimen of this kind of document. We are weary of saying that the opinions of Government officials, and untechnical persons generally, on a mine are worse than worthless. Lord Kintore, formerly Governor of South Australia, and the Hon. Charles Dashwood, the Government Resident of the Northern Territory, have no qualifications whatever for the appraisal of mines. The use of their names is an injustice to them, and to the public. Nor do we place much faith in the views of either the Inspector of Mines or the Government Geologist; such officials are rarely competent to give the sort of advice needed by intending shareholders. But the chief testimony quoted as to the value of the mining claims is that of Mr. D. D. Rosewarne, not "late," but long ago, Inspector of Mines for South Australia, who was assistant manager to the old company and has been promoted to director and consulting engineer of the new one. He "reiterates his view as to the phenomenal mineral wealth of the territory," and "pledges himself to justify the expectations which were held out a few years ago." This last reference to a former fiasco is almost pathetic, and disarms our further criticism. But we advise shareholders to shy at anything "phenomenal." A phenomenon is an appearance; it is not a reality. The prospectus assures the subscribers that they will "also be creditors." They are likely to remain so.

Zinc Metallurgy.

For some time it has been known by hearsay that experimental work on a large scale in connection with the treatment of complex zinc ores is being conducted at Trollhattan, Sweden. Public information regarding the process is now available for the first time, owing to the controllers of the works seeking English and German capital for the purpose of continuing the trials and enlarging the plant. About a year ago the Norse Power & Smelting Syndicate was formed in London for the purpose of taking an option on various electric smelting and power companies in Norway and Sweden controlled by Mr. Knut Tillberg. Mr. F. W. Harbord was instructed to make an examination of the process and the works. His report was moderately favourable, so the option has been exercised, and a company called the Hydraulic Power & Smelting Co. was registered last month. The capital is £1,000,000 in shares, and £875,000 of debentures has been issued. The whole of the share capital (except seven signatory shares) and £400,000 in debentures have been paid as purchase price to Mr. Tillberg and his nominees, as well as £100,000 in

cash; £475,000 of debentures has been subscribed in England and Germany, and of the money thus raised £350,000 will be available for extensions of plant. The negotiations, the technical examinations, and the organization of the business have been in the hands of Messrs. Percy Tarbutt & Co. and the financial members of their group. The property acquired by the company consists of the entire share capital of companies operating at Trollhattan, in Sweden, and Sarpsborg and Tysse, in Norway, together with certain specified water-rights and options held by Mr. Tillberg. The new capital is to be applied, as to £100,000, for increasing the capacity of the Trollhattan works to 15,000 horse-power, and, as to £250,000, for erecting a new plant at Tysse with a capacity of from 30,000 to 40,000 horse-power.

In our 'Précis of Technology' this month we give an abstract of Mr. Harbord's report, and we publish a map showing the position of the various centres mentioned. We may state briefly that the ore, after being roasted and mixed with flux and sufficient carbonaceous material to reduce the oxide, is delivered continuously into a furnace, and that the heat is obtained by the resistance of the charge to the electric current, which enters by two movable carbon electrodes suspended through the roof and leaves by another electrode in the bed. The zinc is volatilized and is caught as far as possible in the condensers in liquid form; most of the lead and silver accumulates at the bottom of the furnace; while the sulphur left in the ore collects copper and iron, and forms a matte. The actual reactions are more complicated than this, but the outline is sufficient to give a general idea of the process.

In considering the application of electricity to the treatment of zinc ores, the efficiency of the process and the cost of the current are the two dominating factors. As regards the latter, a furnace at Trollhattan is rated at a maximum of 350 hp., and treats rather less than 3 tons of roasted ore per day. The price of a horsepower-year is 30s. 3d., so we may take the cost of current at 30 shillings per day when the furnace is working at full capacity, though the actual power consumed will depend on the nature of the charge. Mr. Harbord reports that, in his experiments, 550 tons of roasted zinc-lead material was treated in 27½ days in seven furnaces, and that the price paid for power was £267. As compared with the cost of heating by gas in the standard retorts in Wales, Belgium, or Germany, where the zinc works are adjacent to coalfields, this charge is decidedly high. When the extension of the works has been effected according to the programme of the new company, the price paid for current will naturally be reduced. At the proposed works at Tysse it is estimated that with a plant generating 30,000 horse-power, owned by the company itself, the cost of current should be only 14 shillings per horsepower-year. Under such circumstances the success of the venture from the point of view of cost of power will be more hopeful. The Tysse installation will also be more favourably situated as regards freight on foreign ores, for it will be at tide-water, thus obviating the railway charges that form a serious item in the cost at Trollhattan.

After carefully reading Mr. Harbord's report we cannot say that we are greatly impressed with the efficiency of the process. It is admitted that the recovery of zinc is low, and that when complex argentiferous sulphides are treated the average extraction is not more than 60%. One great drawback is the fact that a large proportion, probably 30%, of the distilled zinc is deposited as powder and a small amount also as oxide; these have to be returned to the furnace to form part of a subsequent charge. If the powder were fairly pure zinc, it would require no further treatment and would be saleable for several well known purposes. Unfortunately it contains much lead, and oxide of lead, so there is no alterna-

tive but to return it to the furnace. Thus the cost of treatment per ton of zinc is greatly increased. The zinc condensed to liquid also contains lead, and requires refining, which is done in other electric furnaces. It is claimed that the refined zinc is unusually pure and that it will command an enhanced price in the market, though Mr. Harbord rightly remarks that the demand for this quality is limited and that any large supply would annihilate the premium. There are losses of zinc, lead, and silver in the slag, and, in addition, a small amount of these metals goes into the matte. Some of the zinc and silver is saved as skimming, and this and the matte require further treatment. Mr. Harbord suggests many ways in which improvements can be made. The present cost of electrodes is staggering, amounting to £204 during the treatment of the 550 tons of material already mentioned.

Before concluding we may mention two further points. One is that a great many other people are experimenting on the same lines and that theoretically their furnaces both in principle and in method of construction are practically identical with those at Trollhattan, so the relative skill of manipulation, attention to detail, and cost of power will decide the actual success of any of these rival processes. We may instance the Imbert, which is being tried at the Hohenlohe Huette in Germany, the Louvrier-Louis and the Cote-Pierron, which are being experimentally used in France, the Snyder process in British Columbia, and W. Mc A. Johnson's process, described in our 'Précis of Technology' this month. The Imbert process is, as a matter of fact, under option in London to a Broken Hill group that had previously backed the present venture, and in all probability we shall hear something of it publicly before long. Whether the transfer of the interest is due to technical or stock-exchange considerations we are unable to say; from the investor's point of view we consider the terms of the present issue none too attractive.

The second point to which attention should be drawn is that the practice in zinc metallurgy in retorts has been so much improved during the last year or two that the lead content is no longer a drawback; in fact, the buyers desire to have at least 5% lead, for this is found useful in collecting the silver, and the leady residue left in the retorts is sent to the lead furnace. It is only recently that we commented on this new phase of the zinc-lead problem, and we then recorded that the slime from Broken Hill, if concentrated by flotation and judiciously mixed with the zinc product, is profitably marketable. It appears, however, that, in negotiations with German and Belgian firms, all sorts of difficulties are raised, and when the sale of concentrated slime without admixture with zinc material is proposed the terms and conditions become impossible. Thus the Broken Hill producers are desirous of trying some alternative process for the purpose of realizing the great accumulations of slime. The Sulphide Corporation is the only Australian producer that is selling slime concentrate to the newly formed firm, the others apparently waiting for the Imbert process to become established. We have made these candid criticisms of this Norwegian scheme, but we have no hesitation in saying that the venture, with its resources of money, talent, and power, will do great service in advancing our knowledge relating to the possible applications of electro-metallurgy.

Agricola.

On another page we publish an excerpt from that celebrated medieval book 'De Re Metallica,' by George Agricola, as translated by Mr. and Mrs. H. C. Hoover. Even the few paragraphs that we quote afford an interesting comment on mining affairs as viewed by an authority who lived and wrote four hundred years ago. The good sense and quiet

humour of the ancient writer will appeal to those who have taken an interest in the recent discussion on speculation as a factor in the business of mining. Apparently the essential human frailties of those that operate mines remain the same although the industry itself has undergone vast changes. It is interesting also to note, from this single quotation, that the idea of risk and of returns proportioned to the chances of a hazardous financial operation, was firmly fixed in Agricola's mind, which grasped the basic factors in 1556 better than some of our friends in 1911. He refers to trickeries that have survived even to this enlightened period of the world's history, but the old commentator takes a cheerful view and concludes that such divagations are not inherent in the industry, for "mining is a calling of peculiar dignity."

Agricola, whose great work, the 'De Re Metallica,' was published after his death in 1555, was a scientific man in the broadest sense of the word, and he deserves his high rank among those to whom is due not only the advance of systematic mining and metallurgy but of science in general. He was the first to make scientific deductions from carefully collected data and he was the first to break away from the superstition of the Middle Ages. To him the science of geology owes the first explanation that the earth's crust is built largely out of water deposits; that the configuration of its surface is due to volcanic action and erosion; and that orebodies are the result of deposition by water in open spaces within the rocks. The science of mineralogy owes to him the first attempt at a rational classification of minerals, and the first description of bismuth and cobalt. To him the science of chemistry is indebted for the first textbook on assaying and for a description of over a hundred different processes, of which less than one half had been mentioned previously in writing. Finally, to Agricola the miner owes the first account of underground methods and machinery, and the first textbook on surveying.

Agricola was by birth a German, his real name being Bauer. He was exceptionally well educated, having studied at Leipzig and at several Italian universities. Moreover, he was not only a mining engineer in the widest sense of the term, but also a mine-owner, having made a competence through participation in the operation of a mine in the Saxon Erzgebirge. His works were written in Latin, and not of medieval character but of the most classic style; they have been translated into German and Italian, passing through many editions and constituting the backbone of mining literature for at least two centuries. Our readers will be interested to learn that a translation of the 'De Re Metallica' has been made by Mr. and Mrs. H. C. Hoover, after several years of laborious effort snatched from amid the manifold occupations of a busy life. We betray no secret in saying that Mrs. Hoover is a graduate in science from the same college as her husband, namely, the Leland Stanford university in California. We are glad to say that the text of the translation is in the hands of the printers; as considerable progress has been made in the necessary annotation, it is hoped to issue the volume early next year. The book is to be reproduced in its original form, the illustrations appearing in facsimile, with a biography of the author and a complete annotation, bringing the history of the allied sciences down to Agricola's period. In view of the fact that Agricola wrote concerning these sciences a thousand years after the language used by him had ceased to develop, he was compelled to employ innumerable adaptations in order to describe the complex subjects of which he treated. Therefore, while the English translation of the book has been attempted by numerous Latin scholars, hitherto they have abandoned the task as soon as they realized their inability to understand the text. It is a case where the translator to

be successful must not only possess a knowledge of the particular sciences involved but be willing to devote the time necessary for a comprehensive study of metallurgy and the allied arts in the Middle Ages, as obtainable from other sources; mere transliteration would not suffice to give the modern reader an informing appreciation of this venerable volume. The English version of Agricola should be of the greatest interest to mining engineers especially, and to scientific folk generally, in affording a clue to the origin of many technical methods and scientific ideas. To the translators we extend hearty congratulations on an achievement of the first rank.

Prestea.

It is a pity to belabour any single episode, or "to chew the rag" as the Americans say, but, on the other hand, it is desirable to get at the truth of disagreeable incidents with a view to obtaining guidance in mining affairs. We referred to the Prestea affair last month and commented upon the hiatus between the chairman and the manager, the one stating at the general meeting that the mine could supply 30,000 tons for the 110-stamp mill when completed, at the end of the current year, while the manager in a letter to the board of directors asserted that it would be impossible to hoist more than 15,000 tons of ore per month "through the existing shafts." To the comment then made we have to add another paragraph based on further information. The simple fact is that the chairman and the manager did not compare notes, *ils n'etaient pas d'accord.* Mr. E. C. Homersham took charge in January, succeeding Mr. Walter Broadbridge. The chairman, Mr. Edmund Davis, who naturally knows more about markets than mines, prepared his speech and submitted it to the consulting engineer of the Central Mining, late Wernher-Beit, group. That gentleman glanced over it cursorily and gave it his imprimatur. At that time the mine manager was about to start from the Gold Coast for a holiday in England. Mr. Davis made his speech and greatly pleased the shareholders. He asked them to "bear in mind" the fact that "with the 110 stamps and the plant connected therewith—the erection of which was being gradually completed —the company should be able to treat 30,000 tons per month." With this equipment "the profits should, if all went well, be at the rate of £20,000 to £25,000 per month, and he (Mr. Davis) trusted that they (the shareholders) would be satisfied with the forecast he had outlined, as he felt confident that it would be realized." In reply to a question he removed any doubt that might have lingered by saying: "As to the 110 stamps, the directors believed that the full plant would be at work in November or December next, but it was absolutely impossible at the moment to definitely fix a date." It always is impossible to fix a date when a new plant will start, for delays are proverbial, but it is possible to know whether a mine can make an output of 30,000 tons or only half that tonnage. Unfortunately the manager did not read the account of the meeting and was even unaware of the task allotted to him until incidentally a conversational reference was made to the matter by the chairman in August. This, of course, caused some perturbation and necessitated the circular issued by the secretary on September 1, correcting the error. All of which shows a slackness of administration that is simply astounding. We understand that Mr. Miles Sharp, of the New Modderfontein, will be sent by the Central Mining group to ascertain what the Prestea can do and what it cannot do. His report will be awaited with keen interest. Incidentally, it may be added that the annual report of the directors, issued in June, does not give the estimates of output and profit furnished by the chairman at the meeting, but it does say that "the erection of the 110-stamp mill is

progressing as rapidly as possible." It seems only reasonable for a shareholder to infer that the 110-stamp mill was being erected to crush ore and that it would be supplied with ore to its full capacity. The unusual number of the stamps is due to the fact that the complement includes the original 60-stamp mill and one of 50 stamps acquired from the Attasi Mines Ltd., a defunct enterprise that operated 60 miles from the Prestea. At the mine it is stated that if 30,000 tons could be hoisted, the crushers could not treat such a tonnage, and if the crushers could do so, the aerial tramway would be incapable of transporting it. Additional equipment to the tune of £150,000 is required before the optimistic programme of the chairman can be made a cheerful reality.

East Rand Proprietary.

The fiasco acknowledged on September 2 has not received any official explanation as yet. The cryptic circular of the company, the bald and unconvincing statements of the chairman, and the untechnical comment of the financial Press have all served but to leave confusion worse confounded. On September 22 it was announced from Johannesburg that the Government would appoint a committee of investigation " with a view to discovering the cause of the leakage." This committee was to consist of Mr. R. N. Kotze, Government Mining Engineer, Mr. J. G. Lawn, formerly professor in the South African School of Mines and Technology, but now consulting engineer to Barnato Bros., and Mr. P. Ross Frames, the managing director of the Premier Diamond company. On the 26th, an official notice was published at Pretoria stating that a commission had been appointed " to enquire into the situation of the East Rand Proprietary Mines "; this commission consists of two magistrates and the Government Mining Engineer. Thus the representatives of the bench replaced those of high finance, with Mr. Kotze as a *tertium quid*. Next day an application was made by the Company for an interdict restraining the Commissioners from proceeding with the enquiry, on the ground that the ordinance under which the Government purported to act did not warrant an investigation of private affairs and that the proper procedure was a private enquiry under Section 96 of the Companies Act (Transvaal), which corresponds with Section 109 of the English Consolidated Companies Act. Under this section a Minister may, on application from shareholders holding an aggregate of not less than one tenth of the shares, appoint inspectors to investigate the company's affairs, with power to examine its officers and agents under oath. This protest succeeded, for on the 28th the solicitors representing the Government and the Company signed an agreement whereby an application was to be made in accordance with the company law quoted above. The Company guarantees the cost of the enquiry and authorizes the Minister of Mines to publish a report embodying the results of the enquiry, the Government withdrawing the notice appointing its own Commission. On September 23 it was stated that Mr. W. A. Caldecott had ascertained that the slime plant was overloaded, so as to require the addition of 10 vats and one tube-mill, thus confirming the information previously published in our last issue. On the same day Sir George Farrar sailed for Cape Town on his way to Johannesburg with the avowed purpose of investigating " the circumstances surrounding the temporary loss of gold at the reduction works " of the East Rand Proprietary. In an interview published in *South Africa* the chairman of the East Rand talked to a reporter without giving any information beyond a general intention shortly " to satisfy and reassure " the shareholders. On September 27 a rumour that the mill was about to be closed down caused a further relapse in share quotations, to $3\frac{5}{16}$. Next day the Lon-

don sub-office of the Company published a cablegram from its Johannesburg headquarters stating that this rumour was unfounded and that work was proceeding satisfactorily, 150,000 tons of 6·9 dwt. ore having been crushed up to September 26. To complete the story of this unfortunate episode, it remains to state that as early as January last a bet was made that East Rands would go to 75s. before September; it is a fact that what is known on the market as the clever brigade sold East Rands consistently during the first six months of the present year: also it is generally understood that the Anglo-French Exploration Co., with a board that includes many of the gentlemen directing the East Rand Proprietary, sold its holding long before any acknowledgment was made that affairs had gone wrong. These sinister facts afford an appropriate background for an episode that has seriously shaken public confidence in Rand mining enterprises.

In order to understand the technical aspect of the case, it is necessary to explain that the East Rand reduction works consist of four mills, ranging in age from 14 to 4 years, and varying so much in their design as to illustrate the recent growth of local metallurgical practice. Similarly the mines consist of diverse units in varying stages of development. Both mines and mills were placed, by the consolidation of companies, under one complex management having most of the defects and few of the benefits expected from an amalgamation of interests. The act of consolidation was followed by the promulgation of an ambitious programme and the promise of a production proportioned to the optimistic views of the chairman and his friends. The management received orders to increase the output to a tonnage permitting of dividends at the rate of 40% on £2,500,000, which is the nominal capital of the enterprise. Only as lately as May Sir George Farrar stated at the annual meeting that dividends at this rate could be maintained. But they could not be maintained at 40%. The chairman ought to have known it, if he did not. Those in charge of the mines and mills certainly knew it, for they were hopelessly trying to perform the impossible while well informed speculators in London and at Johannesburg were selling their own—and other people's—shares with the foreknowledge that a breakdown was inevitable.

The trouble in the mill does not explain the fiasco; it is true a difficulty with the cyanide solution did hinder efficient extraction, but that was only a symptom of the inefficiency due to an attempt to exceed the real capacity of the mill, and of the mine. The discrepancy in the mill-returns became manifest, it is said, as early as last November. It began even earlier. The effort to force the pace had failed more than a year ago, and all the subsequent efforts were unavailing. When the yield began to fall short of the figure required by the official programme, those in charge covered the shortage by adjusting the returns. This can be done in many ways, from trespassing on a reserve of bullion to simple manipulation of figures. Our information indicates that when the yield was seen to be inadequate it was improved by postponing the clean-up for a day or two, in the expectation, of course, of making a commensurate gain during the ensuing month. When this proved impossible and the discrepancy became still greater it is likely that more days were borrowed from the following month, and that this discounting of the future went on until the difference could no longer be obscured. A day of accounting came, and with it all sorts of vague explanations with a view to allaying the anxiety of shareholders. The causes that led to poor extraction in the cyanide annex will, we presume, be explained and rectified; but they are only a symptom of the underlying trouble. In order to make the enormous production required to pay a

profit proportioned to the market valuation of the mine, that is, to furnish dividends at the rate of 40% on a capital of £2,500,000, it was necessary to increase the output of ore from 156,000 tons per month, as it was in February of last year, to 202,400 tons, as it was in July of this year. The bigger duty of the mills was supplemented by additional equipment, such as new amalgamating plates and cyanide vats, all of which entailed some absorption of gold. Moreover, such additions to the plant as were made proved inadequate, for the number of vats and other mill-parts was not properly proportioned at the start, so that the cyanidation became inefficient to the point of entailing a loss. The correspondent of *The Times* says it was 13,000 ounces, and gives that as the full measure of the deficit; as if a loss of £52,000 worth of gold were adequate explanation for a depreciation of £6,250,000 in the value of the property, the shares falling from $5\frac{3}{4}$ to $3\frac{1}{4}$. Despite all the official protestations it seems inevitable that the capacity of the mine, as well as of the mill, is a factor in the problem. When the output of ore was being raised from 156,000 to 200,000 tons per month it became necessary to press the stoping. This entailed the breaking of low-grade stuff. A manager who is told to make a profit in excess of the normal capacity of his mine will either select rich stopes or increase the tonnage. The latter plan was adopted; of course, it was accompanied by a decline in grade, which it was hoped to rectify slowly by sorting as the tonnage increased. On paper, the management confirmed the chairman's promises, augmenting the output progressively and maintaining for several months a yield of 5·9 dwt. from 6·6 dwt. ore as against an average of 6·5 dwt. from 7 dwt. ore during the whole of last year. Sorting declined from 8·75%, the average amount of waste rejected in 1910, to 5% in August 1911. The management carried out the programme on paper, but they were unable to exceed the capacity of their mines and mills; they fell behind; they smothered the truth, hoping to 'catch up,' but they failed to do so, because the poor precipitation in the zinc-boxes proved a culminating handicap. Finally they threw up their hands and announced a discrepancy. Obviously, the sudden decrease of profit announced for August is the acknowledgment not of a catastrophe in that particular month but of cumulative errors in the returns issued during many months. The fiasco is the result of an optimistic programme that taxed the resources of the mines and mills to the breaking point; it indicates a serious error of judgment. It does not mean that the consolidated mines are incapable of making a steady production of 200,000 tons monthly, if sufficient time is given to prepare them for such a performance; nor does it mean that the mills cannot be readjusted and equipped for the treatment of such an output. It does mean that up to date the capacity of the mines, mills, and the management, of the East Rand Proprietary has been over-estimated by about 25 per cent.

Grinding Machines.

It is announced from Johannesburg that the Mines Trials Committee has rejected the Giesecke mill, having ascertained that it did not fulfil the guarantee made as to efficiency. Until that committee's report is published the points of weakness will not be fully known, but we have already indicated, in our August issue, that the wear and tear is excessive, due probably to the use of liners to which springs are attached. However, the experiments with this device and the attention drawn to them will serve a decidedly useful purpose. As Sir Henry Roscoe used to say, when a lecture demonstration failed to yield the expected chemical reaction: "Though the experiment did not succeed, the principle remains the same." Undoubtedly the principle of the ball-mill crushing remains one to which prac-

tical mechanical engineers will do well to give renewed attention. The tube-mill has come to stay, and its older step-brother, the ball-mill, is destined to be resuscitated vigorously and effectively. This has already happened at Kalgoorlie, a metallurgical centre worthily known for enterprise and originality. The coarse crushing of the ore by stamps involves a delay in the discharge of the product, while the ball-mill type of grinder ejects the ore as soon as it has been reduced to a given size. This is the fundamental difference between them. Whether a ball-mill and a tube-mill in tandem is an effective arrangement may be questioned. The speed at which the ball-mill is revolved is not likely to be conducive to a maximum of efficiency on the part of the tube-mill portion of the arrangement. Moreover, the two portions of the machinery represent two stages of grinding and it may prove advantageous to size the ore particles between these two stages with a view to returning the over-size for further preliminary comminution. In the meanwhile enterprising mill-men will look with renewed interest at Chilean, Krupp, and Hardinge mills, with their variations on the same principle. As a page from experience we note the article by Mr. J. W. Hutchinson, the superintendent of the Goldfield Consolidated mill, in Nevada; in that valuable record, as published by the *Mining and Scientific Press*, it is stated that an addition of 40 stamps, 3 tube-mills, and 25 concentrators was under consideration. But this involved a large increase of floor-space, structural steel for building, and enormous concrete foundations. Also it entailed a delay of six months, with an additional expenditure of $175,000. As an alternative it was decided to use six Chilean mills between the existing stamps and tubes. The battery-screens were changed for 12-mesh to 4-mesh and a duty of 8½ tons was obtained, followed by classification of the product, the over-size being fed to the Chilean mills, discharging through 16-mesh screens and delivering, after further classification, to the tube-mills. This arrangement saved 3 months in time and $100,000 in money. No additional building was required, yet the alteration increased the capacity of the plant by 40%. We commend this episode as a suggestive application of re-grinding machinery before cyanidation.

Deep Mining at Bendigo.

The mines of the Rand appear destined to have undisputed claim to maximum depth, as well as aggregate productiveness, for the deep mines of Bendigo have, one by one, been forced to cease operation at the lowest levels. Twenty years ago a dozen mines on the New Chum lode, which is the anticlinal axis of a series of saddle reefs, could claim to have the deepest shafts of any gold mines in the world. At that time Lansell's 180 mine, with a depth of 2650 feet, was the pioneer. Since then the persevering miner has gone to 4614 feet, this being the greatest depth attained by the shaft of the Victoria Reef Quartz mine. Owing to a withdrawal of financial support by the representatives of the Lansell Estate, the chief contributor, the work was stopped, despite a grant by the Mines Department of a subsidy on the basis of sharing the expense equally. The objective was the saddle formation cut in the neighbouring New Chum Railway mine at 4154 feet, which, allowing for the pitch of the orebody, would bring it into the Victoria Reef Quartz claim at about 4800 feet. All the deep mines on the New Chum line have ceased operation, the deepest work in progress now being at 1100 feet in the Ironbark mine, some distance north of the famous group on the north and south slopes of Victoria Hill, where Ballestedt and Lansell first proved the vertical persistence of the saddle-reef formation forty years ago. The orebody cut by the New Chum Railway at 4154 feet gave an average yield of 6½ dwt. per ton, hence the effort to intercept it at a greater depth indicates the pluck charac-

terizing our old friends at Bendigo. We doubt whether much has been lost, in an economic sense, by the decision to stop sinking. It is our opinion that the mining companies at Bendigo have been playing a losing game ever since they operated at a depth of over half a mile ; some ore has been found and some dividends have been paid, but not nearly enough to compensate the losses. Deep mining has its own fascination, but the experienced miner in his introspective moments will confess that the big winnings are usually made nearer the sunlit surface. At Bendigo the big bonanzas were largely in the zone between 500 and 2000 feet. We note with pleasure that lateral prospecting at shallower levels is now the fashion at Bendigo and that a systematic effort is being made to test the intermediate anticlinal axes parallel to the main lines of reef. This is a policy recommended by the present writer 20 years ago.

The Generosity of Science.

Knowledge, especially that part of it relating to technology, grows by the accretion of experience. We do not live by ourselves, much less do we perform professional work in isolated units; on the contrary, co-operation is an essential factor of success. Such generalizations are prompted by observing the curiously anti-social efforts of technical men to solve problems on their own account, without any serious attempt to ascertain whether others may not have encountered, and overcome, similar difficulties elsewhere. For example, at the Dharwar Reefs in India and at the Ashanti Goldfields in West Africa the presence of graphite interferes with amalgamation ; at the Lancefield mine in Western Australia both arsenic and graphite hinder the extraction of gold in the ore, at the San Francisco del Oro in Mexico the refractory element is arsenic, and at the Suan mine in Korea the gold and copper are associated with bismuth, which renders the ore refractory. As to the last of these we count with perfect confidence in seeing the details published at an early date, in our own columns or in those of a worthy contemporary, for we know the generous temper of Mr. H. Collbran, who controls the operations of the Suan mine. As for the other four mines mentioned, we have no reason to impute any littleness of spirit to the management, but we may be forgiven for anticipating the argument that the information available is as yet inconclusive, and, such as it may be, it is the property of the company at whose expense it was obtained, and not that of the public, whether technical or lay. An example of a more generous spirit is afforded by the directors of the Globe & Phœnix mine, in Rhodesia, by whose permission Mr. H. T. Brett was enabled to publish an account of his successful experiments in treating an ore rendered difficult by the presence of antimony in the form of stibnite. We shall be surprised if this publication does not lead to an exchange of ideas and experience with other metallurgists to whom antimony has at other places proved a bugbear. We know of what we speak, for this very result has followed from similar publicity, notably in the discussions relating to pyrite smelting, sampling of ore, and cyanide practice generally. If directors will recognize that the frank give-and-take among technical men can do no harm and is likely to be of mutual good service, they will encourage the members of their staff to record their experience, and thereby contribute to the improvement of mining and metallurgical methods.

An appeal may be made to the officials of companies on the narrow ground of enlightened selfishness, such as is essential to the success of corporate affairs. We hazard the statement that neither graphite nor arsenic, neither bismuth nor antimony, as an obstacle to the treatment of gold ore, is anything new ; on the contrary, the same trouble in different guise, it may be, has been faced by millmen

and metallurgists at other localities. The gentlemen in India and Rhodesia, in Mexico and West Africa, may have discovered a remedy better than any heretofore found; and they may not. It would be well for them to ascertain what others have done and begin by describing their own experiments, even if abortive. There is no greater mistake than to suppose that only the successful experiment is valuable and worth recording. It is worth while to indicate to others the paths of investigation that lead nowhere, so as to save fruitless search; it may prove advantageous to describe a failure for the sake of the hint that turns failure into success; it is not a barren duty to record efforts in one direction that may throw light even in an opposite direction. To professional men we can appeal without hesitation, for we know that most of them have discarded the pitiful idea that to give away information is to squander a stock in trade; on the contrary, the best of them know well that to do a thing oneself is an experience quite distinct from reading how another has done it and that the writing of a description or analysis of the method employed only helps to fix fundamental principles and to clarify obscure facts. In the free-trade of science, as in the charity of every-day life, it is more blessed to give than to receive.

Nipissing and Camp Bird.

We are indebted to Mr. Willet G. Miller, the Provincial Geologist of Ontario, for a historical note concerning the incident that led to the first purchase of the Nipissing mine from its original discoverers. As Mr. Miller himself says, the memories of men are rendered fallible by time, so that fantastic tales arise concerning the discovery of famous mines. Yet, in many cases, as in this of the Nipissing, the fact is fully as interesting as the fiction. That a purchaser of rare minerals should have seen an article in a technical journal and be led thereby to investigate the value of a new discovery, which eventually proved to be a great silver mine, is more notable than that a young man hunting wild game should be shown some rich specimens by a prospector and should forward these specimens to a wealthy father in New York who then sent a cheque in purchase of the mine. We have only to add that the story as told to us came from a mining engineer who obtained his information direct from Mr. Earle. This also illustrates another curious human tendency, namely, that of the discoverer himself to vary the story of the episode that led to the acquisition of a bonanza until by a sort of subconscious metamorphism the facts are given a form apparently more attractive. We recall another case: that of Thomas F. Walsh, the fortunate discoverer of the Camp Bird mine in Colorado. Not long before his useful and honourable life came to an end, Tom Walsh, as he was called in the West, gave an address before the Colorado School of Mines and recounted some of his experiences with a view to emphasizing the value of technical science, especially mineralogy. As an illustration he told how he had discovered the Camp Bird mine. In 1894 he had acquired the Hidden Treasure, a low-grade silver-lead mine in Imogene basin, near Ouray, Colorado. On one of his visits thither from Silverton, where he was operating a small smelter, he noticed a 'slide' (or talus) "of red pyritiferous porphyry," because it had "a very strong indication of gold in or near it." Samples of this rock assayed $2 in gold. This "confirmed his suspicion" that there were gold veins somewhere in Imogene basin. Among the claims acquired by him in the hope of obtaining silicious ore for his matte-smelter at Silverton, was one near the porphyry 'slide' and he suspected that the vein on which this claim was located must pass "through or near the porphyry dike and that it carried gold." So his faithful henchman Andy Richardson was told to drive a tunnel through the snow lying

on the mountain-side with a view to breaking some samples from the abandoned workings. But that did not suffice, Walsh felt that he must take his own samples, so he went himself and found "a dump of very showy ore, having zinc, lead, and some copper pyrites." The rest of the story is best told in his own words: "I went inside and examined the vein. There I found an 18-inch streak of the same kind of ore that was on the dump. Between it and the hanging wall there was about 3 feet of modest-looking quartz. . . . . As I examined it closely I saw little specks and thread-like circles of glistening black mineral all through it, which experience told me was gold in a telluride form." Samples of this quartz assayed "as high as $3000 per ton."

This, of course, was what he honestly believed on May 22, 1908, when he was addressing the mining students, but it is not the story as related by himself, in the presence of Andy Richardson, to the present writer in July 1900. We were standing in Imogene basin and looking at the steep slope into which the Gertrude workings had penetrated, with the dump and talus, of which mention has already been made. In July 1896 he was making a visit to the Hidden Treasure. Looking up toward the steep slope leading to Red Mountain he noticed some pink spar; this reminded him of the fluorite associated with gold ore at Cripple Creek, where he had operated the Deerhorn and Summit mines a few years earlier. In September he returned to the locality and decided to investigate the workings from which this pink spar had come. The rest of the story is as he stated, but the pink spar was rhodonite, the silicate of manganese, and the black threads of glistening mineral refer probably to information obtained at a much later date, when it was ascertained by microscopic investigation that the black threads in the richest of the Camp Bird ore consisted of free gold, galena, blende, and occasional traces of a telluride, the identity of which was never ascertained with certainty. In any event it was not recognizable by the naked eye and bore no likeness to the calaverite and sylvanite so common at Cripple Creek, where the discoverer of the Camp Bird had obtained the particular experience to which he referred.

But this does not exhaust the romance of the Camp Bird nor that of the Gertrude claim, with its curiously prophetic suggestion of the Santa Gertrudis, which, in Mexico, was destined to redress the balance of the exhausted wealth of the Camp Bird, in Colorado. An earlier chapter remains to be read. The Gertrude in Imogene basin was located by William Weston and George Barber in 1877 and was one of the claims acquired by the Allied Mines Co., in 1878. The workings found by Walsh in 1896 were made by H. W. Reed and Caleb Reed in 1884. Mr. William Weston was manager for the Allied Mines, a wild-cat enterprise on which Dr. R. W. Raymond reported adversely in 1878. On the dismantled window-ledge of the assay-office of the Allied Mines Co. in 1896 was found a piece of ore similar to that which Walsh proved to be so rich and which gave a key to the treasure-vault that made him a multi-millionaire. Good reason exists for believing that Mr. Weston assayed the ore for silver only and that he failed to part the button. Silver mining was then the vogue in that part of Colorado. The ore contained only a little silver, the vein was considered unprofitable, and remained disparaged until Walsh had his samples assayed at Ouray 18 years later. Mr. Weston still lives, an honoured citizen of Denver, and we need not dwell on the bitter irony of fate that led him, with his certificate in assaying from the Royal School of Mines, to miss the opportunity of a lifetime. If he had parted those little buttons of silver he would have found that they contained a large proportion of gold and he—not Walsh—would have been the discoverer of the orebody that gave fame to Walsh and to the Camp Bird company.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

Sept. 1911.	August 1911.	Sept. 1910.
£55. 7s. 1d.	£56. 7s. 6d.	£55. 6s. 5d.

The steadiness of prices in face of demoralized markets everywhere is truly remarkable. While copper and other industrial shares, under the influence of political scares, dearer money, and fears of trust prosecutions in America, have suffered severe depreciation, the metal itself has borne the shock with firmness. This undoubtedly points to a small bull interest, and at the same time the reasonable prices and the enormous consumption discourage bears from operating. The European absorption of copper shows no sign of saturation, and if the various troubles that have afflicted markets in the past few months have affected the issue of new orders, the check has been only temporary. Moderate prices ruling over a long period have encouraged enormously the present demand, and we must conclude that this process will continue until stocks are sufficiently exhausted to affect prices, when again consumption will be checked. Meanwhile fresh electrification schemes are being fostered. The increasing output from the new 'porphyry' mines in America is probably no more than the expanding growth in demand will require. The Amalgamated interests are practically out of the market at the prices they are quoting. Other producers have shaded quotations, but insufficiently to attract big business. Stocks in consumers' hands must be small; a substantial buying movement therefore is bound to follow as soon as the large producers make up their minds to meet the market.

LEAD.

Average prices of soft foreign lead:

Sept. 1911.	August 1911.	Sept. 1910.
£14. 15s. 1d.	£14. 1s. 4d.	£12. 12s. 6d.

Lead has advanced steadily and rapidly, and a further rise of nearly 20s. has been made. At the end of the month some profit-taking by speculators was in evidence, and a little bear selling accompanied it, but when consumers showed a disposition to take advantage of the lowered prices sellers withdrew. The position is one of undiminished strength, consumption being far in excess of present supply; to add to the difficulty Spanish freights have advanced, as prompt steamers are almost unprocurable. There are no reserve stocks anywhere, and still higher prices are in sight.

TIN.

Average prices of cash tin:

Sept. 1911.	August 1911.	Sept. 1910.
£180. 16s. 11d.	£190. 9s. 7d.	£160. 8s. 7d.

Though the market has not been entirely free from the violent see-saw fluctuations which characterize it, the excitement has been rather less than usual. The tendency on the whole has been downward. The attitude of the syndicate is no longer evident, and dealers have been operating with hesitation. The outside public have ceased to take a hand in the game as they are nervous of the labour situation, and of the syndicate's influence. Prices over the month show an extreme fluctuation of £20, cash tin having sold at one time as low as £171. The close, however, shows a recovery from this low level to £179. 10s. Although the outlook is somewhat obscure, the onlooker cannot fail to take an unfavourable view of future market developments.

SPELTER.

Average prices of good ordinary spelter:

Sept. 1911.	August 1911.	Sept. 1910
£27. 12s. 7d.	£26. 11s. 2d.	£23. 2s. 7d.

Conditions have not changed during the month. The convention is not in a position to sell freely, and therefore fails to let consumers have the supplies they require. At the same time their interests are against a further rise. It remains to be seen how they will meet the situation. Outside interests, mainly American, are now competing; dealers have disposed of their second-hand parcels, and are watching the market. In all branches consumers are fully employed.

OTHER METALS AND MINERALS.

Prices quoted on October 7:

SILVER.—24¼d. per oz.

PLATINUM.—178s. 6d. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£53 per ton.

NICKEL.—£170 per ton.

COBALT.—9s. 9d. per lb.

ANTIMONY.—£28 per ton.

QUICKSILVER.—£8. 12s. 6d. per flask.

MANGANESE ORE.—8d. to 9½d. per unit (1%).

IRON ORE.—Cumberland hematite 19s. 6d. per ton at mine. Spanish 19s. delivered.

PIG IRON.—Cleveland 47s. per ton. Hematite 62s. per ton.

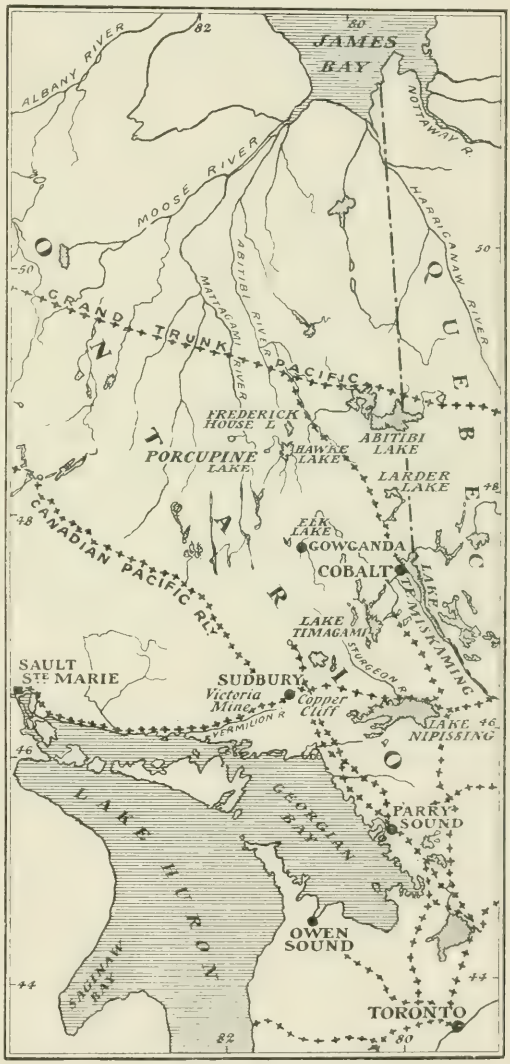
WOLFRAM ORE—31s. per unit (1%).

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

TORONTO.

Porcupine.—The work of reconstruction at Porcupine has made great progress during the last few weeks, notwithstanding the difficulty of getting building material. In the town of Porcupine more than 400 buildings have been erected. Government roads are being rapidly completed, and in many directions heavy teaming can be undertaken without waiting for the cold weather. At most of the mines where buildings and plants were destroyed by the fire, operations have been resumed. It is estimated that about 2000 men are engaged in mining in the district, and 1000 more employed in building and road-making. The Porcupine branch of the Temiskaming & Northern Ontario railway will be extended across the Pearl Lake district through the Hollinger property to the Campbell Veteran claim, where a new townsite has been laid out near the Mattagami river. This is known as Timmins, and will be made the headquarters of some of the large companies operating in the neighbourhood. The most important event during the last few weeks was the discovery of a rich vein on the Dome. In trenching on the eastern part of the property, about 600 ft. from the present workings, a vein 20 ft. wide was encountered showing free gold in unusual profusion, in patches from the size of a pin's head to half-an-inch in diameter. The vein has been stripped for 72 ft., and apparently runs into the Dome Extension. The Dome company has increased its capital from $2,500,000 to $3,500,000 by the issue of additional stock to the amount of $1,000,000, to be taken up by present shareholders. At the Hollinger a new shaft is down 20 ft. and rises will be made from the 100 and 200 ft. levels to connect the workings. A new compressor and hoist have been installed, but the power is not yet available. Two veins carrying free gold have been found on the north lot. One of them is from 2 to 9 ft. wide and has been traced for over 300 ft. A rich vein 22 in. wide carrying free gold and much sulphide has been found on the North Dome. At the Pearl Lake a good strike has been made at 90 ft. in the 'A' shaft. The 'B' shaft is down to the 100-ft. level, where a drift 40 ft. long exposes an orebody 12 ft. wide. A 12-drill compressor and 2 stamps are being erected. The West Dome has installed three boilers of 150 hp. capacity, and a hoist and a power-plant are nearly completed. The company has bought the half-interest of Elijah Woodward and H. M. Pell in the two Kertz claims adjoining its property. A vein with a good showing of free gold 5 ft. wide has been found in the northwest corner of the Imperial property. Two shafts are down on the Rea for 200 ft. Shaft No. 1 will be sunk another 100 ft., making it the



Northern Ontario.

deepest working in the district. About 300 ft. of driving has been done at the 200 ft. level where the vein is 4 ft. wide and free gold has been found in several places. A large quartz vein 60 ft. wide has been uncovered for over 250 ft. and found to be a continuation of the main vein. At the Jupiter two shafts are being sunk; one of them is down to the 100 ft. level, and cross-cutting has begun. A compressor has been ordered. The Plenaurum is sinking two shafts, one north and the other south of Pearl Lake. An 11-drill compressor, a 200 hp. motor and an auxiliary steam-plant have been ordered. At the Foley-O'Brien a new mineralized zone 75 ft. wide has been found on the southern part of the property. A shaft will be sunk and exploration undertaken by steam-drills. A vein 35 ft. wide has been discovered on the Porcupine Reserve property known as the Birke claim, and stripped for 500 ft., giving good pannings. The American Goldfields has resumed operations and is sinking on two veins, from which ore is being extracted. The Eldorado has struck a vein rich in free gold. The Three Nations Co., whose claims are about three miles east of Golden City, has ordered a 7-drill compressor and boilers of 200 hp. capacity. The Reciprocity Mines Ltd. has been organized with a capital of $1,000,000, and has taken over the McKenzie Veteran claim of 160 acres some distance north of the Rea mines. A syndicate of Duluth capitalists has bought the two Sutherland claims in Bristol township for a sum stated at $300,000. The Waters-Harris syndicate of New York has purchased 280 acres southwest of the Hollinger. Numerous discoveries of ore carrying free gold are reported from Thomas, Cody, and Timmins townships.

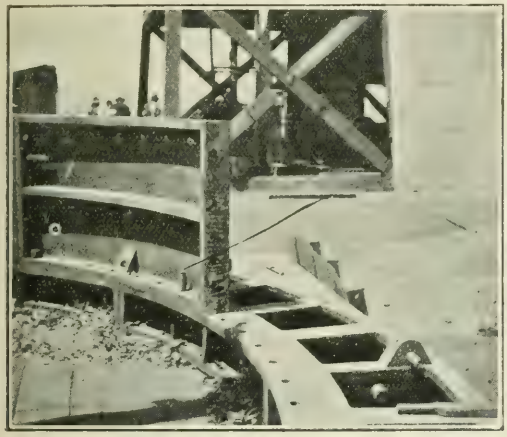
A new goldfield at West Shining Tree, 40 miles north of Gowganda Junction and accessible either from that point by canoe, or by train and canoe from Sudbury, is attracting large numbers of prospectors. The pioneer, Alfred Gosselin, has a claim on which a 10 ft. quartz vein has been uncovered; rich samples have been taken from this, showing free gold throughout. Churchill, McMurchy, Asquith, and Fawcett townships are being rapidly staked and the daily arrivals number 150.

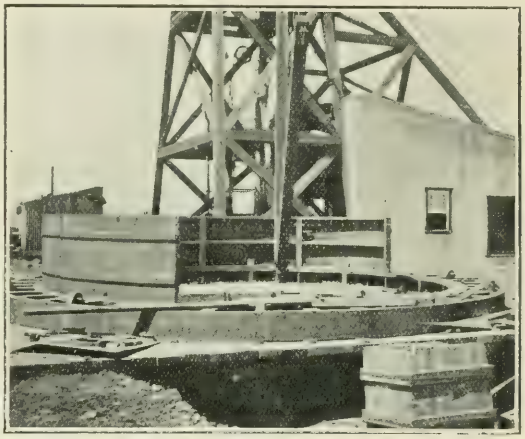
Metal Production of Ontario.—An official statement issued by the Ontario Bureau of Mines gives the output of silver for the six months ending June 30 at 15,231,969 oz. of the value of $7,644,200, being an increase of 2,417,142 oz. and $1,376,670 as compared with the first six months of 1910. Of the total, 430,540 oz. came from Gowganda and South Lorrain. The tonnage of ore and concentrate shipped from Cobalt was 12,001 tons, as against 14,868 during the corresponding period last year. The bullion shipments amounted to 1,302,699 oz. There is a growing tendency on the part of the mining companies to confine their ore shipments largely to high grade and treat the lower grade ore at the mills. One result of this change is the appearance in the official returns for the first time of the by-products of the separation and refining processes, namely, cobalt and nickel oxides, of which 219,584 lb. was produced, valued at $64,876. The yield of gold remains small, being only 2276 oz. valued at $42,320. The output of pig iron was 255,303 tons, worth $3,923,593.

Cobalt.—The difference between the policies pursued by the La Rose and Nipissing companies in the matter of dividends, the former accumulating a large cash surplus by keeping the dividends small, while the other pays heavy dividends and depends for the future on its ability to maintain the present rate of shipments, has been emphasized by the withdrawal of D. Lorne McGibbon, president of La Rose, from the directorate of the Nipissing. It is understood that a difference of opinion on the dividend policy was the cause of his action. The merger of the two companies, which was at one time regarded as highly probable on account of the identity of the interests of the respective directorates, now appears out of the question. President McGibbon's stand, moreover, is taken as indicating that the agitation for an increase in the dividend rate of La Rose is unlikely to be successful. The Nipissing is now treating and refining nearly all of its high-grade ore at its own plant and recovering practically all of the silver. When an outstanding contract for the treatment of ore expires, it will refine all its high-grade, and experiments are being made to ascertain whether second-class ore can also be profitably treated. The saving resulting from the treatment of the first-class ore is estimated at $300,000 annually. The new concentrator at Cobalt Lake mine is ready for operation. It will have a capacity of 75 tons per day at the start, and later this will be increased to 100 tons. The Crown Reserve has declared a regular quarterly dividend of 2% and a monthly bonus of 3%. When this is paid the company will have returned to its stockholders $3,449,181, or over twice its capitalization. No. 14 vein has been picked up at the 150 ft. level where it is 3 in. wide and runs 5000 oz. to the ton. The Temiskaming has made a good strike at the 575 ft. level.

JOHANNESBURG.

Western Rand Estates.—In the Rand a circular shaft is a novelty, and as such the shaft now being sunk on this property is interesting. The position of the shaft seems to have been chosen with the idea of making the work from an engineering point of view still more interesting and instructing; interesting, as it is necessary to sink through soft mud until the dolomite is reached, the whole containing large volumes of water; and instructive, more especially to the company, as the cost will be considerable. The diameter of the shaft is about 18 ft. inside the tubbing, which is suspended from the surface, each ring being bolted into the last as the mud and rock is excavated. The lining is liable to swing out of plumb in case of a mud rush and until a solid foundation is encountered. The accompanying photographs show the nature of the work.





CIRCULAR SHAFT ON THE WESTERN RAND ESTATES.

The Nissen Stamp.—Experiments are being conducted at the City Deep on the Nissen stamp. As is well known, the Nissen consists of a single stamp working in its own mortar-box, the idea being that at every drop of the stamp a maximum of useful effect is obtained, which may not always be the case where several stamp-heads are running together in the same mortar-box, due to the wave motion of the pulp across the dies. Another point in favour of the Nissen stamp would seem to be that the dies wear more uniformly under such conditions as obtain when each stamp has its own mortar-box, than they do in the case of the usual 5 stamps in one mortar-box, where the dies are found to wear most irregularly. From the tests already carried out, it is found that about 30% better duty is obtained from the Nissen stamps than from the stamps as run in sets of 5 in one mortar-box. This may mean either that the Nissen stamp is doing good work or that the rest of the stamps are doing bad work: possibly a combination of both reasons is nearest the mark.

The Prevention of Dust in development drifts of mines during drilling operations was the subject of a paper read by C. D. N. Jourdan, of the Government Mines Department, before a meeting of the South African Institute of Engineers held on September 9. The method of preventing the production of dust is to inject water alongside the drill-bit, while the machine is running. From the tests at the Nourse mine, Mr. Jourdan obtained the following figures proving the saving effected, both in time and steel, by the use of water. In one case it took 93 minutes to drill a dry hole 31 inches, as against 59 inches drilled in 42½ minutes when water was used, both holes having been drilled in ground of exactly the same nature. In another case 48 inches was drilled in 150 minutes, dry hole, as against 68 inches in 87 minutes when using water. In all cases these figures are the results of drilling with the usual machine with cylinder 3¼ in. diameter. It is also estimated, apart from the obvious saving in time, that there is a saving of from 30 to 50% in the drill-bits. Mr. Jourdan states that "the universal adoption of this system seems likely to do away finally with one of the chief causes of the formation of dust in developing drives." It will do much more. With the large number of hammer-drills in use on the Rand at

the present time, this system, if adopted, will increase greatly the underground efficiency for rising and back-stoping generally, and any increase in costs occasioned by extra pipe-laying and pumping will be amply repaid by the saving effected in breaking ground.

Coal Contracts.—It is interesting, in view of the fact that *The Times* engineering supplement of August 2 contained a leading article on 'The Purchase of Fuel,' to record the basis on which the large mining groups purchase their coal. It is bought through the medium of the Transvaal Coal Owners Association, and each purchasing company can select any colliery or collieries under the control of the Association. The quality of the coal supplied is fixed at a given calorific standard for each colliery. The calorific values are ascertained by the Mahler bomb calorimeter, and are calculated upon the coal as delivered to the consumer and not upon dry coal. The classes of coal are:

(*a*) Round Coal (+ 1 in. mesh).
(*b*) Nut Coal (− 1 in. and + $\frac{3}{8}$ in. mesh).
(*c*) Pea Coal (− $\frac{3}{8}$ in. and + $\frac{3}{16}$ in. mesh.)
(*d*) Duff or fine (− $\frac{3}{16}$ in. mesh).

Fine must not exceed 7½% in the case of round coal, 10% for nut, and 12½% for pea, the percentages being calculated by weight. The classes of coal with their average calorific values guaranteed as per Mahler bomb tests are as follows:

Class of Coal.	Average Calories.	
	Round.	Nut.
Witbank.....	12·5	11·9
West Witbank.....	12·2	11·6
Springs.....	10·7	10·2

The calorific value referred to is the larger calorie, that is, the pounds of water evaporated per pound of coal from and at 212° F. The price of coal at the pithead is about 5s. per ton for round and 4s. per ton for nut; in addition, about 8s. per ton is added for freight charges. The ton is the short ton of 2000 lb. Thus roughly the prices for coal, when delivered at the mines, are 13s. per ton for round and 12s. per ton for nut. Assuming that any mine is buying coal with a guaranteed calorific value of 12 C. at 13s. per ton and on analysis the calorific value is found to be only 11·5 C., then the price paid for the coal would be 12s. 5½d. It is interesting to note that the proportion is worked out over the total cost per ton, that is, the pithead-price plus freight-charge, and not on the pithead-price alone, a point which makes it to be to the benefit of the colliery to supply the best coal.

An increase in calorific value might or might not alter its density. As an example, if a poor truck-load containing dense hard shale were compared with a truck-load of clean coal, the density of the material in the former would be greater than that in the latter, but the calorific value of the latter would be greater than that of the former; one disadvantage of buying by weight alone can thus easily be seen. By this system of purchasing coal, the purchaser, knowing that his coal will be of constant quality, gains the advantage of being able to adjust his steam-plant to suit the fuel, and hence obtains a maximum efficiency.

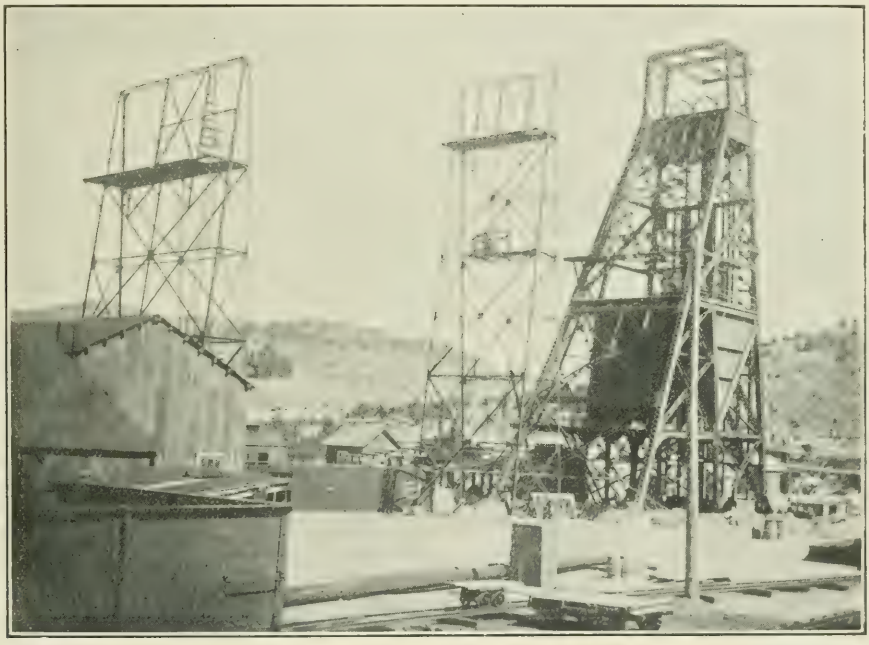
The East Rand Proprietary Mines.—The recent disclosures are, to say the least, astonishing. The position of affairs for some time past has been that the group has tried to maintain a profit beyond that possible with their grade of ore and working costs, in order that a 40% dividend should be declared. This has necessitated running one month's output into that of the next month and so on; for example, if 55,000 oz. was required for the month's output, and if at the end of the month there was still a deficit of 5000 oz., this would be obtained from the first few days run of the succeeding month. Unless therefore there was an appreciable rise in the grade of ore milled, a time was bound to come when the forcing policy must end. This has now happened, and the official statement to account for the fall in profit is to the effect that owing to extraction difficulties there has been lost in the cyanide works no less than 13,000 oz. of gold or about £54,600 of revenue. On the other hand, everything in the reduction works has been watched so carefully to get every possible ounce out of the ore that amalgamating plates have been steamed and scraped several times in a month, and zinc shaving, etc., wasted by cleaning up too closely in the cyanide works. As to the mine, the Cason portion contains the lowest-grade ore, and at present the development in this section seems to be in a particularly poor zone. With a mine of this size, however, having an enormous tonnage of ore developed, it should not be difficult to keep the value of the ore milled at a fairly constant figure. For the way in which matters have drifted on the East Rand Proprietary Mines, the management deserves strict censure, as cases of this kind are calculated to

cause much harm to the mining industry of this country by shaking confidence in it generally.

The Giesecke Mill.—In your issue for August reference is made in your editorial columns to this mill, which the Mines Trials Committee has since apparently definitely rejected on its guarantees. Among those competent to judge, the Giesecke mill was never expected to do all that was claimed for it. Viewed as a glorified tube-mill, there was no real reason to suppose that it would do more than the ordinary tube-mill would do, under similar conditions. Many inventions have been tried on the Rand that were to have superseded the Californian stamp-mill, but none have been successful. This does not prove, however, that a mill of one type or another will not yet be invented, and do better than the gravity stamp. In the meanwhile, every method of crushing should be given a fair trial under actual working conditions, on a large scale, and until such trial has proved the success or otherwise of the innovation, it is bad policy to make statements that may ultimately be proved to be wide of the mark. [According to later advices the Nissen stamp has been adopted at the City Deep on trials showing an efficiency 30% higher than that of the stamp. We await details with interest, for this departure may prove far-reaching.—EDITOR.]

SALT LAKE CITY.

A distressing incident was the fire in the Giroux shaft of the Giroux Consolidated at Ely, Nevada, on August 25. The Giroux is a new 5-compartment shaft that is being sunk and has reached 1440 ft. Ten men were at work in the bottom when they discovered the shaft on fire at the 1200-ft. level. It is believed that a barrel of oil in the pump-station became ignited and exploded, scattering its burning contents, but the exact cause will probably never be certainly known as the only man who could give the information is dead. The men ascended to just below the fire and the party divided, five deciding to attempt to pass through the fire in the cage and five walking through the level to the Alpha shaft, a downcast-shaft 750 ft. farther north. One of the men on the cage was dead on reaching the surface, one died later in the hospital, and the five men in the Alpha workings were all overcome by smoke and gases before reaching the surface, as some excited workman turned on the shaft-sprinkling device without waiting for orders, thus driving the gases of combustion through the Alpha shaft. The accident is even more regrettable in that apparently every precaution had been taken to prevent the occurrence of such a disaster. The fire itself was not a serious matter though the shaft had to be closed and sealed before it was brought



GIROUX SHAFT. STEEL TOWERS TO SUPPORT HOISTING ROPE.

under control. The manner in which the share-market exaggerates the effect of changes for better or worse in mines is well illustrated by this case. The maximum amount of damage that could accrue from the fire would not exceed $100,000, yet the shrinkage in value of the property represented by the decline in quotations amounted to something like $1,500,000. The Giroux Consolidated, it will be remembered, owns the ground lying between the Liberty pit of the Nevada Consolidated and the Veteran mine (formerly held by the Cumberland-Ely, but now a part of the Nevada Consolidated), which includes prophyry ore-bodies not yet fully developed, but known to contain some 10,000,000 tons of ore containing between 1·1 and 1·5% copper. In the Alpha workings replacement bodies in the limestone occur, showing rich copper ore. At the 1200-ft. level the ore is oxidized, and at 1440 ft. the Giroux shaft is still in the zone of oxidation, but it is expected soon to reach the zone of enrichment, when it is hoped that large masses of rich sulphides will be found. A contract has been made with the International smelter at Tooele, some 30 miles southwest of Salt Lake City, for smelting the ores from this mine. F. P. Mills is the manager in Nevada.

The Ely Central, which will long be remembered because of the fiasco in which the notorious George Graham Rice was a central figure, and which has for some time been in the hands of a receiver, is now possessed by the shareholders, the receivership having been recently dismissed by the Nevada courts. It is reported that development will at once begin, but as the ground owned by the company largely consists of a flow of rhyolite, lying between the Ruth and Copper Flat pits of the Nevada Consolidated, it is possible that its chief value will be as a dumping ground for the overburden from the steam-shovel excavations. The Smokey Development Co. which now owns the Turner-Ely ground has begun churn-drilling, and as this company owns the easternmost of the six areas of monzonite-porphyry known to exist at Ely, it is not impossible that good ore may be developed. As matters stand now the Nevada Consolidated owns all the best of the porphyry ore, and the replacement bodies in limestone so far uncovered have not proved of sufficient size to be a source of much profit.

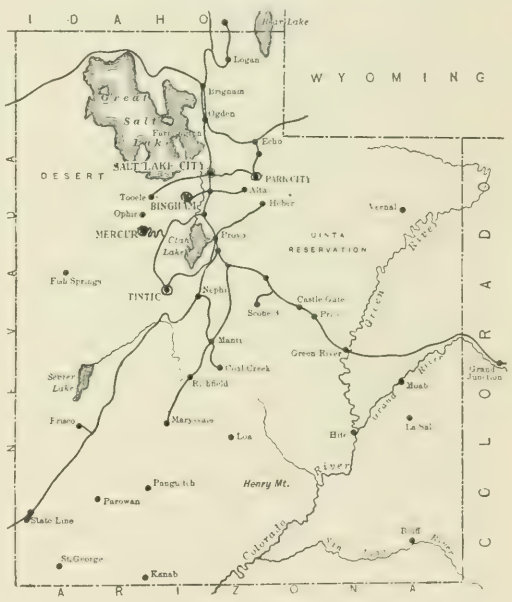
The Nevada Consolidated continues to pay quarterly dividends of 37½ c. per share. In the recent second quarterly report a deficit of $1130 was announced after paying dividends amounting to $750,000 and writing off $137,000 for depreciation. The production during the quarter was somewhat less than the average rate for last year and during July was 1,500,000 lb. less than during the same month last year. This resulted from the treatment of a large amount of material averaging 0·85% copper, representing a low-grade area found in the steam-shovel excavation. As this would require removal in any case, and as it had been already stripped and could therefore be considered free of stripping and mining charges, this low grade ore was sent to the mill. The event proved that it could be treated at a small profit. During the summer it is necessary to operate the mill at a decreased capacity, as an ample supply of water throughout the summer in the arid climate of Nevada is difficult to obtain. The smelter is using oil now only as a fuel in its reverberatory furnaces, and recently the high record of over 600 tons of charge smelted per day was made in one of these furnaces. But as the total given included a considerable quantity of hot converter-slag and cold 'seconds,' the record is not so remarkable as would at first appear, being less than 500 tons per day according to the more usual method of reckoning tonnage. A Pierce-Smith basic converter is about to be blown in; the matte is at present handled in three ordinary converters provided with basic linings.

The Utah Copper Co. with mines at Bingham, some 25 miles southwest of Salt Lake City, and mills at Garfield on the southern edge of Great Salt lake, has been steadily increasing its rate of production and is planning to operate at the rate of 20,000 tons per day; over 15,000 tons is now being handled. The mill recovery has steadily been improved and now reaches over 75% in the Arthur plant (the old Boston Consolidated mill) which is being remodelled in accordance with the best results of the experimental work at the Magna plant. The Bingham & Garfield railroad is practically completed, but it is probable that its employment is delayed pending a settlement with the Rio Grande Western, which claims to have a 20-year contract for the transport of ore at the rate of 12,500 tons per day. At the company's mine at Bingham 18 to 19 steam-shovels are at work, most of them being employed in stripping the orebody. Ore and overburden are being handled at the rate of 50,000 tons per day. The stripping is not yet far enough advanced to allow the full supply of ore to be drawn from the steam-shovel pit, and some 3500 tons are mined daily underground by shrinkage stoping. Only the

excess ore is drawn from the stopes and they are allowed to remain full, so that when the ground is afterward mined by steam-shovel the stopes will not be a source of danger. The ore thus broken and left in the stopes can be handled later by steam-shovels without any subsequent charge for drilling and blasting, so that part of the cost of the present underground mining, which amounts to four times the cost of steam-shovel mining, may properly be regarded as a deferred charge to steam-shovel mining. Within six months it is expected that stripping will be far enough advanced so that underground mining can be discontinued. Churn-drilling continues to extend the amount of profitable ore developed. The greatest difficulty in drilling is experienced in the best ore, which is naturally full of 'slips.' For this reason it has proven impossible as yet to reach the lower limit of some of the best portions of the ore deposits and frequent reports that the ore reserve has been increased by several million tons do not indicate that the previous work was faulty, but merely shows, in most cases, that a drill-hole has penetrated to a greater depth than previous efforts had attained. The Utah Copper Co. now has 25 years' supply of ore, at its present rate of working, fully developed. This averages 1·67% copper and as 1% copper represents the present limit of profitable treatment, it is not at all improbable that in the later life of the mine, when the equipment has been fully amortized, large amounts of material not now regarded as ore will be treated at a profit. At present large sums of money for new construction are being provided out of the operating charges and no regular provision for amortization has yet been made.

The Ohio Copper Co. with mines that immediately adjoin the Utah Copper Co. upon the east, has a small area of monzonite in its ground, but its main orebody consists of a sort of stockwork in quartzite. This is now being mined by a caving system, called 'scramming' in the Lake Superior district, at a very low cost. The ore is milled through rises to the Mascot adit, where the company owning the adit transports it at a cost of 15 c. per ton to the Ohio company's mill at Lark. This now has a capacity of 1600 tons per day, but a recent agreement with E. A. Wall, noted for his vendetta against the officers of the Utah Copper Co., provides, according to Press reports, for the enlargement of the mill to 3000 tons per day capacity. It will be remembered that the versatile colonel wished to inject his ideas into the milling practice of the Utah Copper Co. and the results obtained in the Ohio mill will be interesting. The ore of the Ohio averages about 1·3% copper, and general opinion is to the effect that it might operate at a good profit if the work were conducted on a sufficiently large scale. But the company has always been straitened for funds to provide for enlargement.

The Utah Consolidated is now shipping its ore to the Tooele plant by an aerial tramway. An adit is also being driven through the range and it is expected that this will do useful exploratory work as well as provide a convenient outlet for the ore. The Tooele smelter, which is owned by the International Smelting & Refining Co., was in part constructed from the material of the former Utah Consolidated smelting plant at Bingham Junction. The plant has been in successful operation for about one year and has proved unusually free



Map of Utah.

from the usual faults of design, but has been hampered in its operations by a shortage of ore, as the mines have been unable to supply the expected tonnage. Recently it has been decided to construct two lead stacks, which together with a baghouse, are now in process of building. The injection of a third factor in the lead smelting field, in which the A. S. & R. Co. smelter at Murray and the U. S. S. R. & M. Co. plant at Midvale are already prominent, is a source of great interest to producers of lead ore, in the Idaho as well as in the Utah districts, and new contracts are being negotiated at favourable rates.

MEXICO.

Esperanza.—Engineers representing this company have been examining the Escuadra mines in the Taviche district of the State of Oaxaca, and it is reported that the purchase of the mines is probable. With a view to making sure of future mining returns, the men in control of the famous El Oro property some time ago decided to look for other mines, and in 1910 a number of properties were examined but none purchased. The Escuadra mines produced heavily in colonial days, and have been big producers in recent years. They are owned by the heirs of Juan Baigts, the Mexican who was engaged in litigation with American interests over the ownership of the rich San Juan mine in the Taviche district. This litigation grew out of the failure of the Americans, several years ago, to complete a deal for the purchase of the Escuadra mines for 450,000 pesos, the San Juan contract containing a proviso for the completion of the Escuadra negotiations. After the successful development of the San Juan mines by the Americans, Baigts recovered possession under this proviso, but the Supreme Court of Mexico finally returned the mines to the American interests. The price now asked for the Escuadra mines has not been made public.

Cinco Minas.—The Cinco Minas Co., controlled by the Marcus Daly interests of New York, is resuming work at these Jalisco mines. Work was stopped early this year pending an examination under an option granted to English interests. This examination was suspended shortly after it was commenced, owing to the serious situation of the country at that time, and the option expired without any further attempt to complete the work. The Daly interests intend to build a reduction plant, with a capacity of at least 200 tons daily, during the coming year. The mines were purchased about two years ago for approximately 500,000 pesos.

Pearsons.—Francisco I. Madero, leader of the Madero revolution and unquestionably the next president of Mexico, announced recently that Lord Cowdray, head of the Pearson interests in Mexico, had visited him with the object of ascertaining his intentions in regard to the Pearson concessions. He stated that he assured Lord Cowdray that if the Pearson interests had complied legally with the provisions of the concessions granted to them by the Diaz government, they would have nothing to fear from his government, as he expected to respect all contracts and concessions executed in legal form by the former government. He stated, also, that he told Lord Cowdray he looked on the action of the Pearsons in fighting the Waters-Pierce Oil Co. in the Republic as a great benefit to Mexico, as he was absolutely opposed to monopolies.

Oil.—It is estimated that the present wells in what is known as the Tampico territory—south and west of that Gulf port—are capable of producing 200,000 barrels of oil daily. At least half this amount is credited to the big Potrero gusher of the Pearson interests. With the completion of a contract for a second oil-depôt, at Kilometre 5 on the Tamiahua lagoon, the Doheny interests will have storage for 10,000,000 barrels. The contract is for one hundred 55,000-bbl. steel tanks, and the tanks are being erected at the rate of one every three days. The construction of a 10-in. pipe-line from the Doheny wells in the Juan Casiano field to this depôt has been commenced. The Texas Oil Co. has let a contract for sixty 55,000-bbl. steel tanks, and has surveyed a pipe-line from its proposed depôt on the Panuco river to the Topila and Panuco fields. It is reported that the Doheny interests have in prospect an important contract for crude oil with the Hamburg-American Steamship Co. The Electra Syndicate, of London, recently brought in a well in the Topila field.

Conchos Power.—The Mexican Northern Power Co., a Canadian concern, has more than 1000 men at work on the Conchos river dam and reservoir in the States of Chihuahua. Scarcity of labour during the period of the revolution delayed the work. Water will be stored along the course of the Conchos river for a distance of 30 miles, and the power generated will be transmitted to the Parral, Santa Barbara, Naica, Santa Eulalia, and other important mining districts of Chihuahua, as well as to the Chihuahua capital and other cities. The enterprise is expected to result in greatly reduced mining and milling costs in the districts supplied with power. It is estimated that the company's plans will require fully 15,000,000 pesos.

Railroad to Bolaños.—English capitalists have become interested in plans for a railroad from Zacatecas, or a point near there, on the Mexican Central line of the merger system, to the old Bolaños mining district in northern Jalisco. It is said that should the coming year open with a promise of permanent peace in Mexico these plans will be matured. The famous old silver mines of Bolaños were acquired in 1910 by the Bradbury interests of Los Angeles, California, owners of the Tajo

mines in the Rosario district of Sinaloa, and the Mexican Mines Co. was organized to reopen and operate them. A railroad would result in a mining revival in the Bolaños district, which ranked for many years as one of the most important in Mexico.

CAMBORNE.

Levant.—For the 16 weeks ended September 2, this mine showed a profit of £2430, which compares with £3355 for the previous four months. The amount of ore treated was 7919 tons, as against 8566 tons, and the total receipts per ton of ore were 41s., the same as in the previous account. The reduced profit is therefore clearly due to the decreased tonnage, seeing that the average price realized for the black tin showed only a reduction of a few shillings per ton. I notice that the chairman stated that the produce from tin was down, but according to the accounts that was offset by the increased value of by-products, especially arsenic. The expenditure for the 16 weeks was £13,793, or 34s. 9d. per ton, as compared with 33s. 4d. last time. It is, however, useless to make comparisons of working costs from account to account, for annual charges are placed against income when they are paid, instead of being spread over the whole year. The profit being £2430, and £1528 having been brought forward, there was a balance of £3958 available for dividend. When Frank Freathey Oats, the chairman, announced that the committee only recommended a dividend of 10s. per share, absorbing £1177, and leaving £2781 to be carried forward, some of the shareholders of the old school, whose policy is to divide profits up to the hilt and make calls to meet losses, were quite staggered, but fortunately the wiser policy prevailed. The present lease on the property expires in four years, and forced as they probably will be by pressure from the lords, when granting a new lease, to a heavy expenditure on plant at surface for cheapening production and reducing labour to a minimum, and also with the prospect of having to sink the new vertical shaft to facili-

ON THE WAY TO A MEXICAN MINE.

tate cheap working underground, and to enable the men to get to and from their work quickly, it would have been folly on the part of the committee not to conserve their resources.

Wheal Kitty.—This successful little mine is at present under a cloud. The grade of the ore has fallen, and according to the sales at the ticketing the recovery is now only a little over 20 lb. per ton, so that the expenses are dangerously near the receipts. However, St. Agnes is the district of surprises, and the sett is in the centre of what has been proved to be a rich mineral belt, and it will be surprising if the development work does not result in another good bunch being found. The lode referred to by the chairman at the last shareholders' meeting as having been discovered in the 540 cross-cut south from Sara's shaft, has unfortunately been in disturbed country ever since. Three slides have been already met, but it is hoped, when settled ground is reached, that the lode will resume at least the same value as when it was first cut. The pitwork in Sara's shaft is not quite complete, the delay in finishing this work being due to the non-delivery by the local foundry of essential parts. Another month or so should see this work completed, when sinking is to be vigorously resumed to intersect the main or Wheal Kitty lode, which has been the objective since the inauguration of the company.

Botallack.—I hear that in draining the old mine, large quantities of broken ore have been discovered, and that Frank Merricks is proceeding to the mine to inspect. If his report confirms the manager's estimates, the company will be able to stop treating waste heaps, and keep the mill fully employed on mine ore of fair grade. The ore discovered is in the stulls and has been presumably left behind when this part of the mine was being worked for copper.

West Kitty.—It is pleasant to be able to report a hopeful discovery of ore at the Wheal Friendly section of West Kitty. In the deepest part, the 80 fm. cross-cut, the West Kitty lode has been cut, and is found to be 6 ft. wide and to assay 100 lb. per ton. In all probability the lode will be lost for a time, owing to the disturbance by the main cross-course, but by sinking the shaft deeper it will again be found. T. H. Prisk, Jr., has done much good work at this mine and fully deserves the success which now appears in store. The discovery will be encouraging to the neighbouring mine, Wheal Kitty, because it is for this lode that the new Sara's shaft is being sunk.

Wheal Coates.—Last month I mentioned that this property at St. Agnes is being kept unwatered to the 50 fm. level, awaiting the provision of additional capital. The owners are now erecting a permanent pumping plant, and have already purchased from Wheal Merth a horizontal compound engine equal to a 60 inch Cornish engine.

The Prince of Wales mine at Calstock, in East Cornwall is being worked on a small scale, and capital has been raised for the purpose of developing a lode found recently. It is reported that 1000 tons of ore from this lode has yielded 20 tons of concentrate. Josiah Paull and William Thomas have made inspections of the mine, and both have written favourable reports. I hear that the Drakewalls in the same district is to be given another trial.

Basset & Grylls.—This mine at Wendron is temporarily closed, and an effort is being made to raise further capital for the purpose of sinking the shaft another 20 fm., opening a level at this depth, and cross-cutting to intersect the Wheal Cock lode. This mine is a promising venture, and it would be a pity if its development was not continued, seeing that so much money has already been spent. Unfortunately too much capital has been sunk on dressing plant, before the underground development has warranted it.

MELBOURNE.

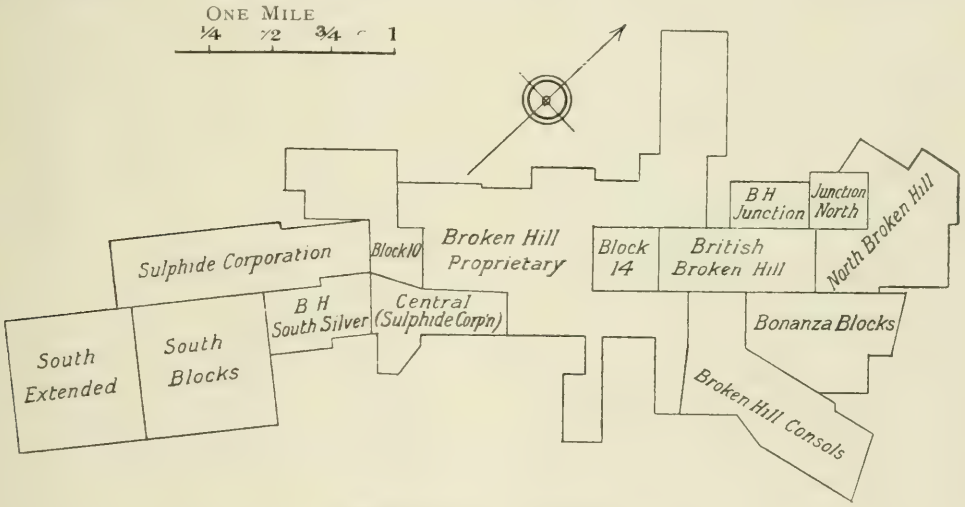
Broken Hill.—Most people are now satisfied that the new orebody found in the British mine in the neighbourhood of Thompson's shaft is an important one. The estimates of content vary from 800,000 to 1,250,000 tons. Should the diamond-drill at the No. 3 level intersect the orebody, a considerable increase will be made in these figures. An important development has been at the bottom (No. 9) level, where the orebody has been proved for 80 ft., the ore being of splendid average quality. Details as to assays are not available, but it is generally believed that the content runs 16% lead and zinc, and about 9 oz. silver per ton. If this estimate be correct then indeed the company has added so much to its ore reserve as to give it a new mine.

For years the great trouble at the Barrier in connection with flotation processes has been the treatment of slime. The Minerals Separation has made the greatest progress in this direction by combining the use of oil and acid in a heated solution. Now it is publicly stated that the Amalgamated Zinc is experi-

menting with an adaptation of the hot sulphuric acid process as developed on the Broken Hill Proprietary mine. The chairman of the latter company when speaking at the annual meeting of the shareholders a few days ago stated that the process was working well and that it had been decided to install a new plant for dealing with the slime. The Amalgamated Zinc washes the zinc residue free of slime, but if it can handle slime with this hot acidulated solution so much the better. The way this company came into the business is that it had an option on the Potter process, which was the original in Australia of the hot acidulated solution method. Litigation in respect to these processes is still going on; the latest victory is that of the Potter company with respect to a claim it had

	1906. Tons.	1911. Tons.	Ore Treated Yearly. Tons.
Proprietary	3,500,000	2,250,000	125,000
Block 10	1,000,000	555,000	100,000
Central	3,623,000	3,600,000	230,000
South	1,400,000	3,500,000	330,000
South Blocks	400,000	500,000	120,000
North	600,000	1,500,000	260,000
Junction	200,000	300,000	—
Junction North	124,000	350,000	150,000
British	600,000	800,000	150,000
Block 14	220,000	220,000	—
	11,667,000	13,475,000	...

The remarkable fact about these figures, which are certainly conservative, is that the ore reserves have increased over what they were five years ago, despite the large quantity of sulphide extracted in the meantime. It will be noticed he only puts the ore reserve



THE BROKEN HILL MINES.

made on the Sulphide Corporation to answer certain interrogatories in connection with the Minerals Separation process, which the Sulphide Corporation employs. The Broken Hill companies that have dumps of slime for sale have, as a result of the progress made in the treatment of that elusive material, practically all contracted for the disposal of all such material at exceptionally good prices. Consequently no one was surprised at the meeting of the South Broken Hill company the other day when F. C. Howard, the managing director, announced that this important mine also was taking into consideration the treatment of its slime.

A review of the position of the Broken Hill mines has been prepared by the *Argus* representative, who makes the following computation of the ore reserves at the different mines: of the British at 800,000 tons, whereas apart from the new strike the company had 450,000 tons developed. Another point that is shown is that the grade of the ore declines with depth. As demonstrating the growth of the zinc industry on the Barrier, he gives the following interesting official figures:

	* Value Total Output. £	* Value Zinc Output. £
1906	2,187,930	†182,793
1907	3,097,551	364,791
1908	2,068,983	443,609
1909	2,082,306	763,229
1910	2,433,297	952,249

* Represents export values (net).
† Includes magnetic separation products.

When it is remembered that these figures represent the result of the flotation process it can be seen what an important bearing that metallurgical discovery has had on the in-

dustry. The figures were given after a personal inspection of the district.

Queensland. — The Chillagoe company's statement of accounts is in one way satisfactory ; but in another it calls for comment. The net profit shown is under £11,000. This represents the returns from two railway systems and a metallurgical business. On the face of it such figures appear poor, though it has to be remembered that the company has spent £36,000 during the twelve months in exploratory work on different mining propositions which were offered to it for purchase. It acquired some of these properties and these now stand in the books of the company at nothing, as the whole of the cost was written off in the £36,000 just mentioned. The earnings on working account really amounted to over £90,000, so that from the industrial side the company did well. It has of course a large debenture debt, against which the holders have the security of the company's railways and works. The railways have given the company control of a large area in Queensland. It is a mineral-bearing country and is far from having been thoroughly developed. Therefore the policy of using the funds of the company in testing various properties is a good one, and a single rich mine would repay the whole of the outlay many times over. It is in this light that the directors of the company view the future of the organization. In their eyes to stand still means to go backward. At the same time they have decided to curtail expenditure in the Etheridge district. What they are doing now is to develop the coal resources in the Mount Mulligan district, which will provide cheap fuel and so make a tremendous reduction in smelting costs.

The most interesting piece of news in regard to copper mining in North Queensland is that a scheme is on foot for the amalgamation of the Hampden and Mount Elliott companies. We in Australia think that we are able to manage mines better and are freer from Stock Exchange influences than directorates in London. If it was felt that such an amalgamation would vest the control of the combined properties in Australian hands, such a scheme would have general support here. It is recognized that the management of the Mount Elliott mine of late has been efficient, and that it would be a gain to both properties to have the cash resources of the Mount Elliott applied to the development of the claims held by the Hampden, also that it would be of advantage to the Hampden to be able to flux its ores with those of the Mount Elliott. A further advantage would be that the two companies would not compete for any outside properties of promise that may be discovered by prospectors. The Hampden company has just acquired the Trekelano claim on advantageous terms, and developments are most promising. Then again such an amalgamation would enable control to be exercised over outside companies like the Hampden South Consols and the MacGregor, while if the railway was extended to Mount Cuthbert, ore could be shipped thence to central smelters at Mount Elliott or Hampden. Furthermore the question of the concentration of the low-grade ores has to be considered, and it is thought by some of the directors of the different companies that this could be undertaken by a strong amalgamated concern. So it will be seen that there are interesting problems ahead for those leading the way in North Queensland copper mining.

Bullfinch.—The people on this side of the world are intensely amused at the course of events in connection with the Bullfinch district. Thanks to the sturdy attitude of the Melbourne Press, Victorians kept out of the Bullfinch boom, while in Adelaide the people went nap and lost their money. The Bull Ant arrangement is regarded as an exceedingly sagacious deal, whether intended to be so or not. As matters stand in the Victorian market, Bullfinch stocks, unless dealing is prompted from Adelaide, are a dead letter. Of course Bullfinch Proprietary may astonish its supporters and the public, but so far the indications in that direction have not been such as to induce large buying on this side of the world.

Victoria.—Gold mining in Victoria unfortunately shows few signs of revival, but there seems to be a chance for deep alluvial mining in the New Langi Logan lead near Ararat. This district in the early days was an important producer of gold, over 280,000 oz. being won in one year from shallow workings. The leader in the district at the present time is the Cathcart, which is working on a tributary lead. The New Langi Logan company is making for the main gutter and within a short time will be boring with the object of draining it, so that rising into the wash may be started. If gold is obtained in sufficient quantity, there will be a big revival in the district. This is most desirable in view of the suspension of work at the Berry United claim near Creswick. The latter is the claim lowest down the famous Berry gutter, in which so much English capital was wasted. The Berry United has been unable to find profitable gravel and so has been

closed down. Over a million of British capital has been spent in Victoria in deep-lead mining with no result. The fact is that the Englishman came too late in the day.

Tasmania.—Mining results at Mount Lyell for the past two months have not been altogether satisfactory. There has been some decline in the grade of the ore at the North Lyell mine and consequently the copper output has been affected. The company is exceedingly reserved in respect to the pitch of the shoot of ore at the bottom level of the North Lyell mine. The most is made of this fact by the shareholders of the Mount Lyell Blocks Co. which owns the adjoining claim. Even if the latter should get the shoot of ore it is hardly possible that it could do more than arrange terms with the Mount Lyell Co., because that company has the only fluxes available in that part of Tasmania.

So far as tin mining goes the Briseis company is doing good work. The yield from Krushka's Flat promises to be satisfactory and to maintain the output until the Ringarooma claim can be developed. At the latter, progress is being made with the removal of the basalt overburden. Tin mining generally is on a good footing, owing to the high price of the metal.

NEW YORK.

Uneasiness over business conditions continues widespread. In the main it must be attributed to uncertainty as to the future, par ticularly as regards tariff and trust legislation. So far, both Congress and the Courts have been much less radical than might fairly have been anticipated, but with a general spirit of investigation and reform in the air, no one knows exactly upon what basis to plan future business. Therefore no one commits himself more than is necessary, and new ventures continue to be neglected. Actual conditions are much better than generally recognized. In August the pig-iron production was 62,150 tons per day as against 57,841 for July, and these figures are representative. In the last three months the much discussed copper surplus has been reduced 32,554,431 lb. As new copper mines come into production old ones drop out and prices have even risen a little. Bank clearances are good and bank balances continue to increase. One of the big Chicago banks now has on deposit the largest amount in its history and the same is true of many others. In that same city, in the down-town district, 11 modern buildings are now being erected and into them will go 67,000 tons of steel alone. Permits have been issued for 8 more buildings calling for 40,000 tons of steel and costing $17,000,000. Such an amount of new construction of one type in one city indicates that conditions are far from bad. None the less, it is true throughout the country as a whole that new enterprises are not being undertaken. The trouble seems to be that money as it accumulates is being hoarded. It is the common belief among bankers that large sums are being put into safe-deposit vaults instead of into banks. The people seem never to have recovered from the distrust of financial magnates engendered by the 'rich man's money panic' of 1907. It must be admitted that the magnates, too, are more than half suspected of withholding money from sound enterprises in order to influence public opinion regarding legislation and regulation.

Michigan is a State sharply divided into two parts, known respectively as the 'Upper Peninsula' and the 'Lower Peninsula.' The latter is a rich farming and manufacturing region. The former is sparsely settled and the chief industry is the mining of copper and iron. Not unnaturally, the people of the two parts of the State are divided on many questions and the matter of taxation is one concerning which there have been many differences of opinion. The farmers in the southern part of the State have heard much of the $115,000,000 in dividends paid by Calumet & Hecla and little of the cost of mining. It is difficult therefore for them to believe that the mines contribute their fair share toward the expense of the State. Recently the State Tax Commission decided to call in an outside expert to examine and value the mines of the State for taxation purposes, and J. R. Finlay was chosen for the task. He was assisted by William Hague and H. M. Chance. Mr. Finlay's report, which was made public late in August, has created intense interest. It is not too much to say that no such report has ever before been issued by any American State, and no one seems to know exactly what to make of it. Mr. Finlay has applied to all the mines of the area the well-known principles used by engineers for estimating the present value of properties when working for private clients. The result is dismay on both sides. The farmers are told that the copper mines when rigorously valued, are paying quite their full quota of taxes, while the mine-owners are told that their properties have a present value of only about 60% of even the present depressed stock-market estimates. It is natural for everyone to think more of the value of his property when selling shares than

when listing it with a tax-assessor, and still it is a shock to have the two valuations put side by side. Mr. Finlay refuses to consider, for taxation purposes, the stock-market valuation, since that is based on speculation. He also allows nothing for plant, since the latter is of little or no value when the ore is gone. Further, he allows little or nothing for undeveloped property, since the chance of making a discovery has no present value. Finally, he takes the proved and probable ore, values it on a basis of 14-cent copper, discounts the total for interest according to the number of years necessary to mine and market the copper, and thus arrives at the present value.

Share quotations, which seemed to have struck bottom at the end of August, at last penetrated the false bedrock and kept on going down until late in September. The Steel Corporation's securities led the decline, followed by the industrials and the railroad stocks, and also by practically the whole list of mining shares. On September 25, for example, as compared with August 26, Amalgamated had dropped 10 points; A. S. & R., $8\frac{3}{8}$; Miami, $2\frac{1}{8}$; Nevada Consolidated, $1\frac{3}{8}$; Ray, $1\frac{5}{8}$; and Utah Copper, $2\frac{1}{2}$; while Chino, Goldfield, and Tennessee Copper practically held their own. These losses fade into insignificance, however, in the face of the fall, during the same period, of 14 points in United States common, and of $8\frac{3}{4}$ in the preferred. The United States Steel Corporation has for several weeks been the centre of this maelstrom. During the closing days of the last Congressional session, an investigation of its methods, with special reference to its manner of absorbing competitors, was begun by the Stanley committee, the chairman of which has proposed to keep at the task until the next session. Nothing discreditable has yet been revealed beyond what has long been common knowledge, but in the meantime rumours have been flying back and forth, first to the effect that the Government was going to bring suit to dissolve the corporation, next that the corporation was going to oppose any such action, then that it was planning to dissolve itself, and so on. Finally the Attorney General issued a platitudinous statement to the effect that if the investigators of the Department of Justice became satisfied with evidence of law-breaking, it would be his painful duty to prosecute, but that he, personally, would much prefer to see the Steel Corporation and all others of like nature reform themselves, and save him from this disagreeable necessity. To this, the leading directors of the Corporation, who had been importuned by stockholders and brokers to put an end to their suspense, responded that their consciences were perfectly free from guilt, that the Steel Corporation was, and always had been, most considerate of its competitors and customers alike, and that its present plans included nothing in the direction of dissolution, either voluntary or compulsory. Whereupon the price of steel shares started to rise again. To the disastrous consequences of all this agitation about the steel trust must be added the discouraging results of railroad operation in many parts of the country, announcements of which are of almost daily occurrence. One road, which enjoys an absolute monopoly of traffic in the Northeast, reports a deficit of $1,267,000; this its president attributes mainly to increased wages, which it is not permitted by law to offset by raising its rates. This railroad is underwriting heavy outlays for new construction along a tributary road, and it is matter for conjecture as to what part of this deficit may be due to the generosity of the steel corporation in permitting the railroad to pay $28 for the same identical rails that a German or an English road could send here and buy for $20 per ton.

Governmental interference in business is universally blamed for the present despondency. In conversation with a well-known banker, I was struck with the bitterness of his tone in referring to what he stigmatized as a high-handed attempt of the Government to pull down the whole business structure of the country. No one questions the propriety of the Government's prosecution of offenders in the case of rebates, and conspiracies to defraud or to restrain trade, but much of the material progress of the present era would have been impossible without a certain amount of consolidation and pooling of interests. Such innocent combinations are amply justifiable on economic grounds, but in the eyes of the Sherman Act they are illegal, or were until the recent decision of the Supreme Court mollified somewhat the stringency of the law. Criticism is directed not only at the imperfections and impracticabilities of the anti-trust law, but also at the laxity of the Government during recent administrations in seeking to enforce the law; if more diligence (with possibly less vociferousness) had been shown in upholding the law during the first ten years after its enactment, one of two things would have happened. Either the law would have been repealed or made more practicable before this time, or the more voracious trusts, now so belligerently attacked, would not have been allowed to attain their present proportions.

PERSONAL

A. CHESTER BEATTY sailed for New York on September 30.

HANS C. BEHR and A. M. ROBESON have been taking the waters at Carlsbad.

J. M. BELL will return from Siberia in December.

F. W. BRADLEY has returned to San Francisco from Alaska.

JUAN F. BRANDES has moved from Denver to San Francisco, with offices in the Newhall Building.

HENRY BRELICH has gone to the City of Mexico.

H. KENYON BURCH, mechanical engineer for the Miami Copper Co., is in California, recuperating from peritonitis.

CHARLES BUTTERS sailed for New York on October 11.

J. H. BUTTERS has been appointed chief engineer for the Hydro-electric Power & Metallurgical Co. of Tasmania.

F. T. BYRDE has returned from the Gold Coast.

T. LANE CARTER, now a resident of Chicago, is at Chihuahua, Mexico.

CHARLETON, DICKINSON & Co. will be dissolved, A. G. Charleton and Arthur Dickinson continuing in practice singly.

EUGENE COSTE, lately president of the Canadian Mining Institute, is in London.

J. H. CURLE is at Bagdad.

ROWLAND FEILDING has arranged to sever his partnership in Hooper, Speak & Feilding, the firm returning to the style of Hooper & Speak.

WILLIAM FRECHEVILLE is at Cordoba, Spain.

B. L. GARD'NER went to Egypt at the end of September.

W. S. GIFFORD is in the southern part of the Red Sea oilfield, Egypt.

WILLIAM GOWLAND has been elected president of the Institute of Metals for 1912.

JAMES M. HALL, of Chicago, is at Porcupine.

H. W. HARDINGE is here from New York.

FREDERICK HELLMANN, now residing at New York, and formerly general manager of the East Rand Proprietary, returns to New York on October 18.

C. A. HEUSSLER has returned from Newfoundland.

HOWARD HILL is reporting on the Forbes Reef in Swaziland.

C. BARING HORWOOD returns to the Rand on October 21.

W. H. HOSKING is examining a copper mine in the Shetland islands.

C. E. HUTTON is returning to South Africa.

C. J. INDER has returned from the Ural mountains.

W. R. INGALLS, the editor of the *Engineering and Mining Journal*, is making a tour through the western mining regions of the United States.

E. H. JOHNSON, chief metallurgist to the East Rand Proprietary, is on his way back to Johannesburg.

GEORGE MACFARLANE sailed for West Africa on September 27.

JAMES A. MACTEAR also sailed for West Africa on September 27.

D. P. MITCHELL, manager for Bewick, Moreing & Co. at Melbourne, is in London.

JAMES W. NEILL is in North Carolina.

F. DOUGLAS OSBORNE, on the conclusion of professional work in the Swaziland tinfields, paid a visit to the tin mines in the Northern Transvaal.

FRED P. PAUL sailed for Sydney, New South Wales, on October 2.

FRANK H. PROBERT was at New York recently.

C. W. PURINGTON is expected in London from Eastern Siberia on November 10.

T. H. RETALLACK has gone to Peru on behalf of the Cuta Syndicate.

ALEXANDER P. ROGERS passed through London on his return from Brazil to New York

A. W. ROSS, of Wellington, New South Wales, passed through London on his way to the Bibiani goldfield, West Africa.

G. H. ROTHERHAM is now with the Bantjes Consolidated Mines at Florida, in the Transvaal.

W. N. RUNDALL has returned from South Africa.

W. H. SHOCKLEY is at Lucerne.

A. L. SIMON is again in the Ural region.

THOS. B. STEARNS left London for Denver on September 21.

O. J. STEINHART, of Twite & Steinhart, has gone to Swedish Lapland.

R. C. N. TWITE is in Roumania.

J. C. VIVIAN has returned from the Argentine.

P. B. WAUGH has returned from Austria.

H. E. WEST has arrived from California, after a visit to Porcupine.

LOUIS A. WRIGHT is making a journey across Asia.

THE FINANCE OF A MINE. V.

By M. H. BURNHAM.

THOSE who have read the preceding articles will have noticed that the whole theory of valuation advanced is the simple development of two business concepts, namely:

(*a*) The rate of interest expected from any investment is in inverse proportion to the risk thought to exist.

(*b*) Any investment entails the assumption of a capital return, say, 3%, as the rate realized from securities involving no risk, and a further rate as an allowance for additional risk, counting from the date of investment.

The first premise (*a*) and the last clause of (*b*) have a practical significance often overlooked when considering the construction of a financial enterprise.

For instance: an engineer on the geological evidence before him will allow perhaps a shoot-extension of 100 ft. on the dip as ore for which he is willing to advise payment. Yet few engineers seem to realize that the difference between the present value of the blocked ore and the share value of the company is their real allowance for shoot-extension. As this amount has not only to be redeemed, but an interest must be paid commensurate with the risk, the amount of shoot-extension actually allowed by the responsible engineer is often startling.

Table IV was compiled with a view to setting out current practice in the matter of the finance of shoot-extension, but as the data touching the deferment factors were wanting, the extension necessary to redeem the capital was alone considered. As, however, no one invests to have his capital only returned, calculations neglecting the risk and deferment of return are misleading.

Fig. 5, illustrating the typical copper mine, will make this clearer. The engineer is perhaps willing to allow a shoot-extension to the line *tt*, but the capital of the company less the present value of the blocks really means an allowance to *vv*, essentially committing the engineer to a shoot-extension far beyond that intended: in this case into the zone of primary ore.

The number of levels of shoot-extension involved by the capitalization may be expressed by

Formula VIII.

$$D = r' + r'' + r''' + r''''$$
$$= (1 + r' + r''')^d \ (r' + r'' + r''')$$
$$= (1 + r' + r''')^d \left(r' + \frac{r'}{R^{ky} - 1} + r''' \right)$$

where D is the annual dividend in percentage of the capital remaining, after subtracting the present value of the reserve above the lowest level,

r' = the Consol rate, or 3%.
r'' = rate necessary to redeem the capital in ky years.
r''' = the risk-rate determined upon.
r'''' = the rate necessary to make good the loss of interest due to delayed dividends.
k = the number of years of life to a level
y = the number of levels, or the unknown factor.
d = the years of delay in realizing dividends (not counting the first year).

Of the mines set out in Table IV the Santa Gertrudis is the only one the reports of which, issued at the time of flotation, are available, hence this case will serve to illustrate. The first dividend will have been delayed one year, and taking the life of the reserves above the lower level at two years yielding £250,000 per year on a capital of £1,275,000; also allowing a uniform risk-rate of 5% on these blocks, their present value will be (0·85734 × 250,000) + (0·79383 × 250,000) = £413,000. (See Table VI).

This sum taken from £1,275,000 leaves £862,000 to come from below the lowest level, and will be deferred three years.

As the economic shoot works out at 4000 sovereign-feet and the crushing plant is estimated to crush 160,000 tons, or exhaust one level each year, this means a return of 46% on the remaining capital.

Allowing a uniform risk-rate of 10% for these lower levels, manifestly too low but sufficient for illustrative purposes, trial and error substitution in Formula VIII gives y a value of 5; that is, the shoot-extension allowed by the above capital is really 500 ft. Even if a risk-rate of 5% for the lower levels be allowed, the shoot-extension is nearly 400 feet.

The above results may be obtained without calculation by referring to Table VII, where

TABLE VII.

r‴ or RISK-RATE = 10%.
Real or Present Value of £1 or $1 of Annual Profit in Block.
Rate to be Realized (s) = 13%.

Years of delay (*d*) in realizing dividends from block.	Life of Block (*n*) in Years.				
	1	2	3	4	5
0	0·88496	1·60614	2·20493	2·70981	3·14120
1	0·78315	1·42136	1·95126	2·39808	2·77978
2	0·69305	1·25784	1·72679	2·12220	2·46002
3	0·61332	1·11314	1·52812	1·87804	2·17699
4	0·54276	0·98508	1·35232	1·66196	1·92656
5	0·48032	0·87175	1·19674	1·47076	1·70491

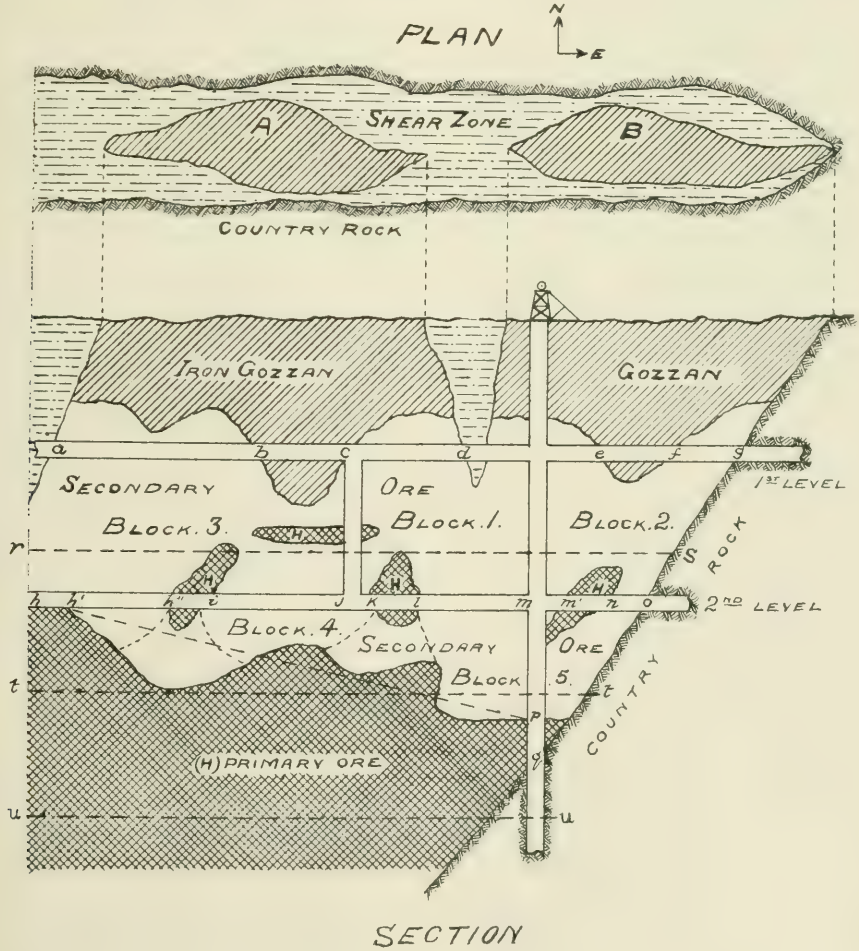


Fig. 5. PLAN AND SECTION OF A TYPICAL COPPER MINE.

it will be seen that, allowing 10% for risk and deferring 3 years, the present value of one pound is £2·17, and the nearest value of n corresponding to $\frac{1}{0{\cdot}45}$ or 2·22 is 5 years. This will be clear to any one who has followed the philosophy underlying the earlier formula.

It hardly seems too much to say that if the application of simple business principles were more generally appreciated by those engineers who specialize on valuation, our position as a profession would be more satisfactory in the body politic. As before mentioned, what with an excess of technique in the curricula of technical schools and the pressure of flotational exigencies, the present position leaves something to be desired.

VANADIUM IN NEW MEXICO

By BRIGHAM LEATHERBEE

IN 1884, F. M. Endlich, manager of the Lake Valley mines, which lie in the southwestern portion of Sierra county, New Mexico, and were famous producers of silver ore to the value of over $14,000,000, discovered in the lead ore of these properties, small yellow crystals which upon examination proved to consist of lead, arsenic, vanadium, and oxygen. In honour of the discoverer, this combination was named Endlichite, and has been so classed by Dana and subsequent mineralogists. During 1896 or 1897, William F. Hall discovered the same variety of vanadium ore in the lead and silver mines he was operating about twenty miles north of Lake Valley, and which have since become the property of the Vanadium Queen Mining Co. As there was no commercial demand for vanadium at that time, Mr. Hall preserved only the finest crystals, which he sent as specimens to a large mineral company in Philadelphia, by whom they were distributed to the various public and private mineral collections throughout Europe and America.

During the winter of 1909, vanadium was discovered on the properties of the Southwestern Lead & Coal Co. on the eastern slope of the Sierra de los Caballos, across the Rio Grande and 40 miles east of the other deposits. This property was then taken over by the Vanadium Mines Co., which is now operating it. The property of the Vanadium Queen Mining Company is situated in the Las Animas district, which has heretofore been considered a gold district, as but little else has been worked here, although some silver, lead, and manganese have been mined. The total gold production from both quartz lodes and placer workings is recorded at over $9,000,000. The vanadium ore occurs in a well defined contact vein, between the shale and lime, which shows numerous outcrops for over three miles; a number of prospecting shafts, opencuts, and tunnels indicate that there is a continuous orebody for this entire distance. The vanadium is found in different combinations, endlichite and vanadinite predominating, and the assays run from 3·25 to 9% in metallic vanadium. So far the management has devoted its entire attention to prospecting along the vein and to opening up the most promising portions, with the intention of having the ore well blocked out before commencing actual operations. In the meantime, constant experiments upon the treatment and reduction of ores have been under way in various metallurgical laboratories, and it is presumed that shortly the first unit of an experimental plant will be installed upon these properties.

The Vanadium Mines Co. controls two fissure veins of vanadium-bearing ore, one of which has been prospected by a 50-ft. shaft, while the other has been more extensively developed and now has the main shaft down below 200 ft. with various levels. The ore is hauled from the mine to the old concentrating mill of the defunct coal company, which mill has been enlarged by a set of Cornish rolls and some new vanners and slime tables. This concentration is being performed as experimental work, the foundations having been laid for a new and permanent plant to be equipped with the latest patterns of the best machinery, as soon as the type of equipment best suited for the ore has been selected. After concentration, the concentrate, which assays about 8·632% vanadium and 59% lead, is transported by mule teams to Cutter, where a large oxide plant has been erected on the Santa Fe railway. The product from this plant is shipped to Rankin, Pennsylvania, where it is made into ferro-vanadium alloy.

Prospecting is being done elsewhere in the county for vanadium and there are many rumours afloat regarding the discovery of valuable deposits.

The Copper Deposits at Alderley Edge, Cheshire, are continually being examined by mining engineers, who hope to turn to advantage the carbonates contained in the Keuper and Bunter sandstones. These deposits have disappointed many workers in times gone by, as the copper content is irregular and of low grade. Lancashire chemical manufacturers have tried extraction by various acids without avail.

TABLE VI.

Real or Present Value of Unit of Annual Profit in a Block of Ore.
For Block of 1 year's life only; Varying Risk-Rates r'''

(d) The delay in years in exhausting the Block.	Risk Rate r''' = 0% return = 3%	Risk Rate r''' = 1% return = 4%	Risk Rate r''' = 2% return = 5%	Risk Rate r''' =3% return = 6%	Risk Rate r''' =4% return = 7%	Risk Rate r''' =5% return = 8%	Risk Rate r''' =6% return = 9%	Risk Rate r''' = 7% return = 10%	Risk Rate r''' = 8% return = 11%	Risk Rate r''' = 9% return = 12%	Risk Rate r''' =10% return = 13%	Risk Rate r''' = 15% return = 18%	Risk Rate r''' =20% return = 23%
0	0.97087	0.96154	0.95238	0.94340	0.93458	0.92593	0.91743	0.90909	0.90090	0.89286	0.88496	0.84746	0.81301
1	0.94260	0.92456	0.90703	0.89000	0.87344	0.85734	0.84168	0.82645	0.81162	0.79719	0.78315	0.71818	0.66098
2	0.91514	0.88900	0.86384	0.83962	0.81630	0.79383	0.77218	0.75131	0.73119	0.71178	0.69305	0.60863	0.53738
3	0.88849	0.85480	0.82270	0.79209	0.76290	0.73503	0.70843	0.68301	0.65873	0.63552	0.61332	0.51579	0.43690
4	0.86261	0.82193	0.78353	0.74726	0.71299	0.68058	0.64993	0.62092	0.59345	0.56743	0.54276	0.43711	0.35520
5	0.83748	0.79031	0.74622	0.70496	0.66634	0.63017	0.59627	0.56447	0.53464	0.50663	0.48032	0.37043	0.28878
6	0.81309	0.75992	0.71068	0.66506	0.62275	0.58349	0.54703	0.51316	0.48166	0.45235	0.42506	0.31392	0.23478
7	0.78941	0.73069	0.67684	0.62741	0.58201	0.54027	0.50187	0.46651	0.43392	0.40388	0.37616	0.26604	0.19088
8	0.76642	0.70259	0.64461	0.59190	0.54393	0.50025	0.46043	0.42410	0.39092	0.36061	0.33288	0.22546	0.15519
9	0.74409	0.67556	0.61391	0.55839	0.50835	0.46319	0.42241	0.38554	0.35218	0.32197	0.29459	0.19106	0.12617
10	0.72242	0.64958	0.58468	0.52679	0.47509	0.42888	0.38753	0.35049	0.31728	0.28748	0.26070	0.16192	0.10257
15	0.62317	0.53391	0.45811	0.39365	0.33873	0.29189	0.25187	0.21763	0.18829	0.16312	0.14150	0.07078	0.03643
20	0.53755	0.43883	0.35894	0.29416	0.24151	0.19866	0.16370	0.13513	0.11174	0.09256	0.07680	0.03094	0.01294

LOSSES IN CYANIDATION

By H. FORBES JULIAN.

INTRODUCTORY.—The interest manifested in the filtration of slime, especially with reference to the prevention of mysterious losses of gold and silver during cyanidation, has of late been much intensified by sundry unfortunate events. The fact that such losses do occur is beyond doubt, but the cause as well as the remedy is far from apparent. It may easily be proved that the presence of slime accounts for much of the loss, which in a measure is preventible by the aid of filters The following few notes touching on the more important uses and features of the vacuum type of filter, may be of service in opening a discussion with a view to elucidating matters.

PREPARATION OF PULP FOR THE FILTER. —There are various sources of loss in the treatment of the pulp before beginning to separate the solution from the solids, but it is not necessary to deal with these other than incidentally, because the filter is capable of augmenting the dissolving treatment and practically eliminating these sources of loss. Suffice it to say that the slime is mixed with solution in the proportion of 1 ton of solid to say 2 tons of liquid (the range in practice is from $1\frac{1}{2}$ to 3) and the mixture is agitated, the object being to facilitate the dissolving of the gold and silver by constantly changing or circulating the solution about the metal-bearing particles, and at the same time to aerate the pulp. In cases where the slime settles readily when agitation is stopped the pulp is thickened, before it is passed on to the filter, by decanting the supernatant solution. A pulp having a consistence of about 1: 1 is generally desired in order to avoid any necessity for agitation while filtering, but in some cases it is not practicable to thicken to this extent and the pulp goes to the filter containing as much as 3 of solution to 1 of solid. When filters are provided with means for effecting a constant circulation of the pulp during filtration the question of thickness resolves itself into one of economy. When the pulp contains less than 1 of liquid to 1 of solid it is not sufficiently mobile for economical handling ; but, of course, there are exceptions to this rule. The coarser the slime particles the less solution need be present.

The thickness of a pulp is generally expressed by the ratio of solid to liquid, which from a given ore is conveniently determined from the specific gravity of the pulp.

CAKE FORMATION AND THICKNESS. — When filtering slime containing much amorphous clay it is good practice to apply a low suction (about one quarter of the maximum) until the cake is about $\frac{1}{8}$ inch thick and then the higher vacuum. By this means a more permeable cake is formed than if the higher vacuum is applied at the start. It is consequently more quickly washed, that is, exhausted of its valuable contents. When the slime consists chiefly of crystalline material (tube-mill product) the effect of the low suction at the start is not so apparent, but it usually results in a clearer filtrate. Operators as a rule, however, pay little attention to this variation in the vacuum, but keep it constant during cake-formation.

The thickness to which a cake is allowed to build-up is governed chiefly by economic considerations. At the beginning of each cycle of operations, when the filter-cloths are clean, the solution filters through readily, and with a constant vacuum the rate becomes slower and slower as the deposit increases. A point is reached when it becomes economical to stop and proceed to wash and discharge the cake and start the cycle again. Exactly when this occurs must be found by trial. It naturally varies with the character of the slime together with the altitude of the locality. In some cases the limit is reached when the cake is only $\frac{1}{2}$ inch thick, as when dealing with highly amorphous or gelatinous material, while with crystalline silicious slime a cake of 2 inches and even more may be economically formed before beginning to wash.

The usual way to find when the cake is of the desired thickness is by direct measurement or by time comparisons, but it is obvious that the rate at which the filtrate is withdrawn may be utilized for this purpose with advantage.

When using a constant vacuum the rate at which the cake forms is shown, graphically, by the parabolic curves in the annexed diagram, Fig. 1. It will be noticed how the rate rapidly decreases as the cake thickens. Thus in the first ten minutes the cake forms six times as rapidly as in the last ten minutes.

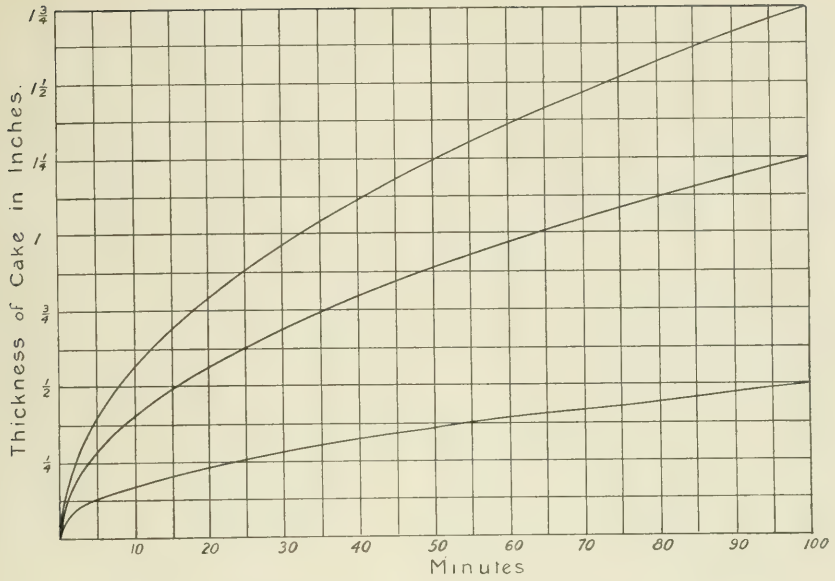


Fig. 1. CURVES SHOWING THE RATE OF FORMATION OF CAKES.

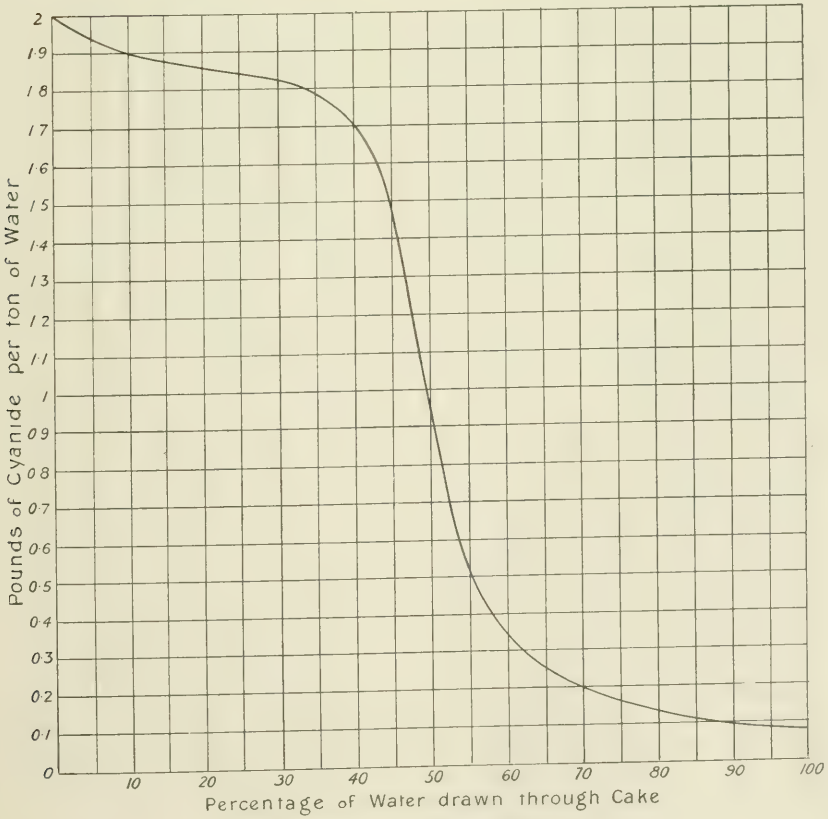


Fig 2. WATER-WASH DILUTION.

For example, if a $1\frac{3}{4}$ in. cake took 100 minutes to form, over in. would have been deposited within the first ten minutes, while in the last ten minutes it would build up only $\frac{1}{1\frac{1}{2}}$ in. Again, if the cake at the end of 100 minutes was only $\frac{1}{2}$ in. thick, about $\frac{3}{8}$ in. would be formed in the first 50 minutes, and it would take another 50 minutes to add $\frac{1}{8}$ inch.

The porosity of a cake is affected by the pressure of formation. Thus a cake deposited by vacuum contains 40 to 65 lb. dry ore per cubic foot, according to the specific gravity and fineness of the material, while the same material filter-pressed in a cake contains 70 to 110 lb. dry ore per cubic foot.

The foregoing considerations supply food for thought to the practical investigator. They give an insight into the reason for the well known fact that high-pressure filters, when dealing with amorphous slime, produce thin sloppy cakes from which the metallic contents cannot be economically and efficiently washed, whereas the vacuum-filter on the same material forms thick, porous, and well dried cakes in excellent condition for washing.

If the filter is to be used simply for dewatering or drying, the curves show graphically how much more economical it is to clean-off at short intervals rather than at long intervals when washing is employed. This is particularly evident with the so-called continuous filters, which, of course, do no effective washing, but simply act as dewaterers.

The permeability of the cake adjusts itself inversely as the pressure of the atmosphere plus the hydrostatic head, and although the cake may be thicker in one part than another it will allow only an equal flow of solution to pass per unit-area of the cake. It is, however, important that the cakes should be fairly uniform in thickness and should not build-up so as to allow two opposite faces to touch or 'freeze' together. An uneven thickness is due chiefly to settling and is most apparent when the pulp is of thin consistence. It may be completely avoided by agitating or circulating the pulp while the formation of cake is proceeding, but if the pulp is sufficiently dense, say, 1 of solid to 1 of liquid, little or no trouble is likely to arise from uneven thickness.

Characteristics of Filter-Cakes.—It is generally accepted that cakes of slime formed by pressure-filters differ in character from those formed by vacuum-filters, although, as is obvious, the formation of both is due to pressure, the difference being only one of degree. It may be that this difference in character is also only one of degree. In practice it has often been shown that when filtering so-called natural slime the vacuum-filter produces not only a thicker cake but one that is more porous and more uniform in its porosity, so that it can be more efficiently washed. On the other hand, when dealing with fine sand or crystalline slime the high-pressure filter produces the heavier cake in a given time, but not heavier in proportion to the power expended and not so uniform in its porosity.

The cake formed on the vacuum-filter consists of an infinite number of layers roughly parallel to each other and the washing is done at right angles to the layers, that is, across the grain of the cake. On the other hand, when forming cakes in the chambers of the filter-press, a segregation of the ore particles invariably occurs, producing a distorted grain and irregular porosity. There is no way of remedying such a defect, because the cake is held between two filter-cloths so as to necessitate the use of a clear wash-liquor that continues to pass unevenly through the cake. With the vacuum-filter the cake has a face in contact with the wash-liquor, which is purposely kept turbid. If there are any parts of uneven flow in the cake they soon choke, causing the porosity to become adjusted until more or less uniform washing ensues. However, when dealing with some classes of ore excellent washing has been done with filter-presses, but my point is that the vacuum-filter has a wider range of application and invariably dilutes the filtrate less for equally satisfactory washing.

Care of the Cake.—During the time that the cake is exposed to the air it should be treated with care. If any appreciable sucking action occurs, air is drawn through the cake, tending to disturb its grain and causing compacting in parts and increased porosity elsewhere. In order to wash such a cake much liquor is required, which results in a filtrate poor in metal. This, however, may be partly obviated by using a highly turbid wash-liquor.

If suction is cut-off the grain of the cake will remain unaltered during the time required for transfer. With cakes held vertically or overhanging the stoppage of the sucking action is not always practicable, because the small amount of moisture always left behind the filter-cloths descends by gravity and should this ooze through to the cake adhesion would fail, causing portions of the cake to fall away. One maker of vacuum-filters successfully overcomes this difficulty by rendering the lower margin of the filter-cloth impervious, thus forming a trough for retaining the drained solution.

It is also important that the cake while exposed to the air should be subjected to as little vibration as possible. If this is violent some cake may be knocked off, but even a slight vibration, although producing no perceptible effect to the eye, may seriously disturb the grain of the cake and spoil its uniform porosity. The risk of injury from this cause is reduced to a minimum by using a non-moving type of filter.

After the cake has been formed and exposed to the air 30 to 35% of its weight consists of valuable liquor, that is, metallic solution formed in the treatment-vats, together with undissolved metallic gold and silver particles or compounds. The former can easily be removed fairly well by means of a water-wash, but if the latter, which is usually by far the most valuable of the two, is to be extracted, a solution-wash is applied before the water-wash.

WASHING THE CAKE.—This operation requires more attention than it usually receives. After sliming, cyaniding, and forming the cake, it is rarely economical to hasten the process at the expense of washing. Too often it happens that filters are so over-loaded with work as to make the solution-washing little better than a farce. There is no excuse for this when we consider that the value of the metal removed by the wash far exceeds the cost of the operation.

The main object of the solution-washing is to extract on the filters the metal that has failed to dissolve in the treatment-vats, or was re-precipitated during treatment, and incidentally to wash out all dissolved metal held by the cakes. Various independent investigations have shown that the gold and silver that remain undissolved in the treatment-vat after agitation are partly dissolved while solution-washing the cake on the filter. The undissolved metal is in two forms: that which is intimately associated or combined in its natural state with the gangue, and that which after dissolving has again returned to a solid state. I refer to this as being re-precipitated. Both forms are recoverable to an appreciable extent, at a trifling cost, after the cake has been formed.

Without going deeply into the chemistry of the subject, which is somewhat obscure, it is enough to say that the gold and silver dissolve on the filter after escaping solution in the vat, but how much of this is metal in its natural state and how much is due to re-precipitation is not discernible. Periodical tests show that the rate of dissolving in the treatment-vat always becomes slower and slower as the operation proceeds, and in time may become so slow that the cost of agitating exceeds the value of the metal dissolving. Theoretically the rate of increase should be only in proportion to the diminution of the surface of metal in contact with the solution, but in practice this is far exceeded; in fact, tests show that at times dissolving appears to cease altogether in spite of metallic particles and free cyanide being present. The phenomenon is explained by the solution becoming degraded in presence of finely divided solids. The term 'degraded' applies to a diminution of the solvent power of the solution due to the introduction, from the ore, of soluble impurities having a reducing action. If it were made possible to bring fresh potent solution continuously in contact with the ore particles, instead of simply circulating the degraded solution, the rate of dissolving would be kept more constant and the tendency to re-precipitate would be minimized.

The vacuum-filter provides means for performing this operation almost ideally. The cake is submerged in a potent wash-solution which is slowly drawn through the pores and in its course dissolves a portion of the gold and silver together with degrading matter, as in the treatment-vat, but as the solution becomes degraded it is drawn forward out of the region of the gold and silver particles and is replaced with fresh potent solution, the action being continuous. In this way the rate of dissolving of the gold and silver, per unit-area exposed to the solution, remains constant. The rate lessens proportionately only as the area of the exposed metal diminishes.

The foregoing applies with even greater force when a compound, such as silver sulphide, is also present. Silver sulphide, although only sparingly soluble, readily degrades a solution, whereby it stops or hinders the dissolving of any metallic gold and silver, as well as further silver sulphide that may be present in the pulp. Various devices are employed for reviving this lost dissolving power in order that the solution may be enriched before filtering, and even when they are effective the dissolved metal is often in such an unstable condition that some of it re-precipitates either in the vat or in the cake. The solution-wash, if properly applied, practically removes the whole of this re-precipitated metal, together with native metal that had hitherto escaped solution.

RE-PRECIPITATION AND RE-SOLUTION.—It has often been observed that a maximum extraction in the agitator-vat is followed by

re-precipitation of the gold and silver. What is not so easily observed and not so well known is that precipitation and dissolution proceed in the vat at the same time, and for this reason among others the gold and silver in the pulp are never completely brought into solution. It is also not realized that this re-precipitated metal does not re-dissolve in the same solution although the native metal may continue dissolving slowly in its normal manner. Without going into the subject deeper, we may say that re-precipitation is due to local action of both a physical and chemical nature. Graphite, tellurides, sulphides, arsenides, charcoal, grease, oils, and even silica or alumina in an extremely fine state of division, precipitate both gold and silver from working cyanide solutions, and this precipitate shows little or no tendency to re-dissolve in the same solution. If this re-precipitated metal be filtered off, washed, and re-pulped with a fresh solution, a portion re-dissolves and if the operation be repeated a further portion re-dissolves. In time nearly the whole of the metal may in this way be re-dissolved. Such a process could not, of course, be employed economically, but the vacuum-filter makes it possible to apply similar fresh solutions continuously and without the necessity of re-pulping. Thus when a fresh potent solution is drawn steadily and evenly through the cake the metallic particles, being continuously surrounded by the advancing liquor, re-dissolve and pass away with the filtrate. This re-dissolving is not instantaneous but requires time for contact; hence a rapid flow through the cake does not hasten matters, but results only in a large volume of filtrate poor in metal. A cake $\frac{1}{4}$ in. thick requires about as much time to be solution-washed as one 2 in. thick.

Silver is much more prone to re-precipitation than gold, and is afterward more slowly re-dissolved on the filter. Even the addition of water to the pulp is sufficient, in some instances, to cause an appreciable proportion of the silver to assume a solid state.

It often happens that scum or froth accumulates on the surface of the pulp in the agitator-vats. This sometimes becomes extremely rich in gold and silver, a large proportion of which may be directly traced to re-precipitation. The enrichment of the scum is evidence of re-precipitation occurring in the mass of agitated slime. It is difficult to bring the solid particles of the scum in contact with a solution in the treatment-vats, but if it be transferred periodically to the filter, along with some slime, it may be solidified with a little trouble into a cake, and freed of metal with a suitable wash-solution.

Preparation and Application of the Wash Solution. — This is usually made from the barren solution that leaves the zinc-box. Before being used it should be thoroughly aerated to ensure complete oxidation of any reducing matter present. If the wash-solution is not already muddy it is advisable to add a little of the finest slime, the object being to provide means for readjustment of any slightly uneven permeability in the cake, such as might accidentally have occurred during the time that the cake is exposed to the air. The solution just before use should be made stronger in cyanide than that originally used in the treatment-vats. How much stronger is found by trial, and if silver sulphide be present the strength of the wash requires special attention. It is generally inadvisable to add free alkali to wash-solutions.

The object of applying this wash is to impoverish the cake with a minimum quantity of solution in a minimum time and obtain a filtrate as rich as possible in gold and silver. As already stated there is nothing to be gained by rushing the solution through the cake at a high velocity. It is only necessary to give it such a rate of flow as would prevent backward diffusion, and if this were maintained the cake would be washed with a minimum quantity of solution and produce a filtrate of maximum richness. In practice, however, this slow rate of flow cannot be employed because it is necessary to accomplish the washing in a limited time, even though the filtrate should suffer in richness. The time allowed by operators to solution-wash the cakes is as a rule absurdly short, with the consequence that great loss in the aggregate occurs. In every case when applying a solution-wash the vacuum should be kept as low as possible for the time allowed.

After completing the solution-washing the cake contains cyanide and should carry only a minute quantity of dissolved gold and silver, chiefly obtained from the barren solution. It is generally economical to save the cyanide by applying a water-wash.

Water-Wash. — One-third of a ton of wash-solution for every ton of ore is retained by the cake. If therefore this solution contains 3 lb. of cyanide per ton the solution in the cake will contain $\frac{1}{2}$ lb. per ton of solid. The object of the water-wash is to remove this half-pound of cyanide, or a large proportion of it for further use, without unduly diluting the filtrate, and incidentally any dis-

solved metal present. Theoretically this would appear to be a comparatively simple matter, for it may be argued that it is necessary to draw into the cake only one-third of its weight in water and thus push forward and displace the retained solution. In ordinary practice, however, it is found that when only this amount of water is used less than half the cyanide and metallic contents is removed. The difficulty is to recover an appreciable amount of the remainder without undue dilution of the stock solution. The curve in Fig. 2 shows graphically the diluting of the filtrate as the water-wash is drawn through the cake, the vacuum being at a maximum and constant. It will be noticed that the first 40% of the filtrate was only slightly diluted (2 lb. to 1·7 lb.) The next 15% caused a dilution from 1·7 to 0·5 lb. per ton. After this the dilution became less rapid and the removal of the cyanide from the cake was comparatively slow. A low vacuum throughout the operation is desirable for a maximum strength of filtrate, but the curve would indicate that a high vacuum at the start would save time if maintained no longer than is just necessary to withdraw the stronger portion of the filtrate, and then if a low vacuum be applied the greater part of the remaining cyanide, being held by adsorption*, and requiring time of contact to diffuse into the added water, would produce a filtrate sufficiently strong not inconveniently to dilute the stock solution. The extent to which the vacuum should be lowered depends on the porosity of the cake, and the length of time that the wash is applied depends on the fineness of the slime. The more porous the cake, the lower should be the vacuum; and the finer and more amorphous the slime, the longer should be the time of contact. There is no way of determining with accuracy the quantity of water giving the most efficient wash consistent with a given strength of filtrate, except by trial.

Washing by Filtration and Decantation. — The simplest of all methods of washing is by decantation. In practice, however, it presents serious objections, not the least of which is the unavoidable loss due to dissolved metal remaining associated with the residue discharged after the final decantation. One example on gold ore will suffice as an illustration. Assuming that the total solution in use is 7 tons to 1 ton of ore, the number of decantations is three and the residue pulp contains 50% moisture. The losses then for various assay-values of original solution are given in the following table, (1) when the added liquor is free from dissolved metal and (2) when, as is usual, the added liquor contains a small quantity of dissolved metal.

(1) Added liquor free from metal.		(2) Added liquor containing metal.					
Dissolved gold before first decantation per ton of solution.	Loss of gold in residue solution per ton.	Loss of gold in pence per ton due to added liquor containing per ton			Total loss of gold in residue solution in pence per ton when added liquor contains per ton		
Dwt.	Pence	2 gr.	3 gr.	4 gr.	2 gr.	3 gr.	4 gr.
0·5	0·94	3·76	5·65	7·53	4½	6½	8½
1	1·88				5½	7½	9½
2	3·76				7½	9½	11
3	5·65				9½	11	13

These are theoretical losses, on the assumption that the moisture after each decantation is reduced to 50%. In practice, it is often difficult to maintain a residual moisture so low, especially in cold weather, owing to the slowness of settling and the necessity for keeping the capacity of the plant abreast of the mill. Thus if the residual pulp contained 60% moisture, instead of 50%, the total loss would be increased by 8%. When we allow for loss due to adsorption which in practice always occurs, the above figures may be greatly increased.

In filtering, unfortunately, there is no simple way of calculating the theoretical loss after washing, for comparison with decantation, owing to a number of uncertain factors. The amount of dissolved metal left in a cake has no relation to the richness of the original solution. Thus if a cake be washed with its own weight of water it matters not whether it contained ½ dwt. or 3 dwt. per ton of solution; the loss in the residue solution would be much about the same. In decanting the metal contents are removed by two to four washes or dilutions, while in filtering it is done by an

*'Adsorption' refers to a surface condensation whereby the dissolved metal and cyanide are held in a concentrated form at the surfaces of slime-particles. The condition increases with the fineness of the slime.

infinite number of washes. It may be proved mathematically that the greater the number of washes with a given quantity of water, the more perfect is the wash. This may be forcibly illustrated by an example: If the total quantity of liquor in use in the decantation process be made the same as in the filter process, say 3 : 1, the theoretical separation of dissolved metal by three decantations would be only 78·4%. In practice 75% would be considered fair work. In the filtration process, with this same proportion of liquor, there is no difficulty in separating 99% of the dissolved metal. Again, in order to get 99% of dissolved metal separated by three decantations it would require a total of 12 tons of liquor to 1 ton of solid. These figures are based on the assumption that the added wash-liquor contains no dissolved metal.

In practice the wash-waters generally contain small quantities of dissolved metal, and the solution in the residue-pulp contains this metal in proportion to the amount of moisture retained, which for filtration is approximately 1 of solution to 2 of solid and for decantation 1:1. The loss of metal from this cause is therefore twice as much for decantation as for filtration. Then again the wide difference in the amount of wash liquor required in filtration and decantation processes affects the cost per ton of ore, in the subsequent treatment of the solution to recover the gold and silver. In filtration the amount of wash-liquor used seldom exceeds twice the weight of the solid, and with care may be considerably less without increasing the unavoidable loss of metal. On the other hand, with the decantation process five of wash-liquor to one of solid is common practice, and this cannot be economically reduced without increasing the loss of metal.

Another feature for comparison between washing by the two systems is the loss due to re-precipitation and adsorption. The decantation process necessarily involves a successive dilution of the solution, on account of the large volumes in use and to prevent excessive loss of cyanide in the residue.

Dilution of the liquor containing dissolved metal, in presence of finely divided solid particles in suspension, invariably results in loss of dissolved metal, whether it be by re-precipitation or by adsorption. The extent to which these phenomena develop depends on the constituents of the pulp and the fineness of the ore particles. Silica, which is generally present in a gelatinous or colloidal condition, has the property of carrying down an appreciable amount of gold and silver and cyanide by merely diluting the solution with water. Hydrated alumina possesses this property to an extraordinary degree. There is no doubt that much of the loss in residue from the decantation process is due to adsorption and re-precipitation, caused by dilution in the washing stages.

These phenomena also take place in the filtration process, but since the solution need not be diluted until the dissolved metal has been removed from the cake by the solution-wash the loss of gold and silver by adsorption is minimized. The loss due to the dilution that occurs in the water-wash is chiefly in cyanide. Again, re-precipitated metal is re-dissolved in passing the strong wash-solution through the cake whereas the weaker solution added in decantation, although potent on natural metallic particles, has but little effect in re-dissolving the re-precipitated metal.

Glaciation.—On Advent bay, in Spitzbergen, a coal entry has been driven 2025 ft. into a hill and at the face the height to surface is 800 ft. Yet the rock is completely frozen all the way, despite the circulation of air from the surface by means of a fan. These were the conditions as observed in July, 1911. Here we have an illustration of the penetration of cold during a Glacial period, that is, of permanent frost able to withstand the seasonal thaw at the surface.

Production of Zinc.—Figures for the metallic content of zinc ores produced in various countries show that Germany heads the list with 230,203 tons, and is followed by the United States with 208,859 tons and Australia with 146,348 tons. The next largest producers are Spain with 69,920 tons, Italy with 42,828 tons, Algeria with 29,652 tons, and Sweden with 28,900 tons. The total production of the world was 855,992 tons.

In the Dutch East Indies by far the most important of the six gold mines is the Redjang Lebong, Sumatra; during 1910 the value of the output was £403,000 and the dividend was at the rate of 100%. The next largest is the Ketahoen, also in Sumatra; the output was worth £114,000 and the dividend was 20%. There are two producers in Celebes, the Totok and Paleleh, yielding £63,500 and £58,500 during 1910 respectively; the latter paid 7½% dividend. The Sintoeroe in West Borneo produced £17,500 and made a small profit. The returns for the Simau in Sumatra are not complete, but during the first nine months of 1910 the output was worth £40,800.

THE OIL INDUSTRY OF CALIFORNIA

By WILLIAM FORSTNER.

THE daily averages of production given in Tables I. and II. show conclusively that there is no increase of oil production in the State of California. Comparing the figures for the months of July 1910 and June 1911, there is a decrease in average daily production of 19,409 bbl., or 8½%. The consumption has, however, increased; again comparing the same months there is an increase in average daily consumption of 18,032 bbl., or 10·8%. Consequently the daily surplus of production over consumption has decreased 50·9%.

The stock on hand on June 30, 1911, was 36,184,788 bbl., an increase of 9,758,819 over July 31, 1910. This amount of stock on hand represents, at the rate of consumption of the month of June 1911, the consumption of six months, and is not excessive. The storing of the oil is, however, costly and has been especially a heavy burden for the Independent Producers Agency, largely composed of small operators. The Agency has at present to care for over 4,000,000 bbl. in storage and this expense has been the cause of much dissatisfaction. The cry about over-production is largely due to the complaints of these small operators, who have not the capital required to operate without immediate returns. The Agency is now perfect-

ing its plans to take care, at a minimum cost, of its present surplus and of that which it presumably will accumulate in the future, so that this difficulty can be considered obviated. The Associated Oil and the Standard Oil companies, the two large marketers in California are also increasing their storage facilities, so that the surplus oil will receive proper care.

The principal market for California oil has been in the States along the Pacific coast, western Nevada, Arizona, and a part of northern Mexico. In the Puget sound region this oil may in the future have to meet the competition of the Katalla oilfield, Alaska, which is entering the stage of production. Nothing has as yet developed in the Alberta field, British Columbia, to justify any expectation of a production of commercial importance.

The price paid for fuel-oil at the wells has fluctuated little during the last few months. From October 1910 to June 1911, the Agency has paid to its members 35 cents per barrel for each month's product. The Standard Oil has cut the price of fuel-oil (heavier than 22° B) to 30 c. per bbl. in April and is still making contracts at that figure. Whether this price will be upheld depends upon the future relation of consumption and production.

As to consumption, this can only be increased by generalizing the use of fuel-oil, and depends on the extent of territory wherein the oil can advantageously replace coal for all purposes that do not require coal as special fuel, and compete with oil from other sources. The radius of territory which a certain field can control therefore depends on whether the price at which the oil can be laid down at the distributing points, makes that oil the preferable and most economic fuel. It is generally assumed in California that with the opening of the Panama Canal this radius will be extended. Water transport through the Canal, will, however, also extend the radius of control of the Texas, Oklahoma, and Mexican oilfields ; and where the boundaries of these respective territories will come has yet to be determined. These fields can hardly compete on the Pacific with California, and the increased maritime movement on the Pacific Ocean will certainly offer an enlarged outlet for California fuel-oil.

To introduce oil as fuel in new territories of consumption, and to induce consumers to adopt its use, it is necessary to assure them a constant supply at a reasonable figure, and therefore the two causes of complaint of the operators, large surplus and relatively low price, tend to the future benefit of the oil business in California, creating a market and extending its territory. Table IV., giving the exports from San Francisco, shows what a relatively small portion of the output of California is exported, both as crude oil and as petroleum products ; also a gradual increase will be noted.

As to production, unless an unexpected number of new wells of phenomenal importance come in within the near future, it is reasonable to expect that the production will remain about at the present figure. The yield of new wells, in the regular course of development, will be counterbalanced by the decrease in production of the older wells. The production of natural gas in the Buena Vista hills, east of Midway, is assuming such proportions that this product may become an important factor. The natural-gas belt has been proved over a distance of 12 miles, with a width of at least one mile. The wells are large producers, with very heavy pressure. The natural gas is used as fuel in the Midway field and is piped to Bakersfield for domestic and other purposes. If it can be proved that the character of this natural-gas field guarantees a considerable length of life for the supply, there is no doubt that it will be piped to Los Angeles and to San Francisco, as even the present output, estimated at 250,000,000 cubic feet per day, would be sufficient to provide the amount required in those cities ; but the experience in the Eastern and Middle West gas-fields, where the supply diminished rapidly, has rendered manufacturers cautious in adopting this fuel, notwithstanding its great advantages. When the permanency of the supply is demonstrated, this product will certainly in many instances displace oil as fuel.

The price paid for fuel-oil at the wells has fluctuated only slightly during recent months ; from October 1910 to June 1911, the Agency has paid its members 35 c. per bbl. for each month's product.

As to refining oil, the difference in production between the lowest month, November 1910, and the month of June 1911, see Table I., is 370,889 bbl. From Table II. it will be seen that the difference in production between these two months for the San Joaquin valley group, 392,118 bbl., is greater than the total difference. The increase in production of the Midway field for the same month was 650,555 bbl. This field produces both refining and fuel-oil. It is impossible for anyone outside of the marketing companies to obtain exact figures of the shipments made by the different producers, but I believe I am not far from the actual facts when stating that at least one half of this increased production was refining oil.

TABLE I.

Production and consumption year ended June 30, 1911.

1910	Total number of Barrels produced	Average Daily Production	Average Daily Consumption*
July	7,207,890	232,545	178,803
August	7,368,320	237,689	178,391
September	6,858,025	228,601	177,438
October	6,552,281	211,364	184,032
November	6,323,189	210,773	190,490
December	6,603,496	213,016	192,553
1911			
January	6,566,180	211,812	179,934
February	5,973,206	213,329	184,365
March	7,089,955	228,708	164,115†
April	6,929,337	230,938	203,170
May	7,113,466	229,467	207,553
June	6,694,078	223,136	196,835

*Consumption is the actual amount of oil moved from the fields.
†This abnormally low figure is due to breakage in the pipe-lines caused by heavy storms.

TABLE III.—Stocks

Oil at terminals and in hands of marketers and producers.

1910		Bbl.
July	31	26,425,969
August	30	28,264,169
September	30	29,799,068
October	31	30,646,429
November	30	*
December	31	32,500,000
1911		
January	31	32,800,000
February	28	33,588,000
March	31	*
April	30	36,525,096
May	31	*
June	30	36,184,788

*Data not available.

TABLE II.

Monthly and average daily production per group for year ended June 30, 1911.

1910	San Joaquin Valley		Coast Group		Southern Group	
	Month	Daily	Month	Daily	Month	Daily
July	5,582,564	180,083	727,970	23,483	918,255	29,621
August	5,591,939	186,378	855,520	28,517	920,862	30,695
September	5,335,182	177,839	625,900	20,863	896,946	29,898
October	4,995,677	161,151	630,610	20,342	925,994	29,871
November	4,817,615	160,587	623,850	20,795	881,724	29,391
December	5,103,748	164,637	643,370	20,754	856,378	27,625
1911						
January	5,109,734	164,830	621,770	20,057	837,676	23,796
February	4,582,676	163,667	625,247	22,330	765,283	27,331
March	5,472,527	176,533	765,131	24,682	852,279	27,493
April	5,248,237	174,941	793,520	26,451	887,580	29,586
May	5,361,356	172,970	764,961	24,676	987,149	31,845
June	5,209,733	173,658	503,420	16,781	980,926	31,697

TABLE IV.

Export of Petroleum and its products from San Francisco for the years ended June 30, 1909, 1910, and 1911.

Crude oil (gal.)	23,289,280	58,558,689	65,029,876
Naphtha „	62,219	126,651	115,194
Illuminating oil (gal.)	68,832,363	38,746,450	39,422,799
Lubricating oil „	433,547	490,114	568,799
Residuum „	48,051	34,428	4,663,373
Total (gal.)	92,665,460	97,956,332	109,809,041

The Standard Oil Co. is the only purchaser of refining oil in the San Joaquin valley. The total amount of oil used for refinery purposes, as far as I can learn, is 400,000 bbl. per month, including that used in the manufacture of asphalt. From the Midway field alone, the Standard Oil runs at present over 500,000 bbl. of light oil, and consequently the price paid for that oil has lately fallen from 65 to 45 cents per barrel. For the same grade of oil 70 c. and more is paid in the southern field, where there is more competition for that product. The Guaranty Pipe Line Co. is constructing a pipe-line from the South Midway field to the coast, with a branch to Los Angeles. This pipe-line will offer a new outlet for the light oils of the Midway field to the refineries in the southern part of the State. The Dutch-Shell people have petitioned for a site to erect a refinery at Martinez, on the upper part of San Francisco bay, which may offer in the near future another outlet for the Midway refinery oil.

Outside of the oil used by the Southern Pacific and the Santa Fe railroads, nearly all the oil produced in California is marketed by the Standard Oil Co., the Union Oil Co., or the Associated Oil Company. The Standard produces far less oil than it uses and markets. This company is therefore a buyer on a large scale, and hence it is to its interest to depress the price of the oil as much as possible. It is the greatest refiner on the coast, and the principal buyer of refining oil. In the San Joaquin valley this company is practically the only buyer of that grade of oil because the other pipe-lines from that field to the distributing points are used for fuel-oil, and therefore it may succeed in keeping the price of refining oil down for a certain length of time.

The Standard Oil Co. is giving several signs of intending to increase its activity in the California field. It is doubling the capacity of its pipe-line from the San Joaquin valley to its refinery at Point Richmond on the bay of San Francisco, and also materially increasing its storage facilities in the Kern River field. It is further reported that this company intends to erect a large tank-farm for the storage of oil at Los Nietos, three miles from Whittier, in Los Angeles county, and has acquired a considerable ocean frontage west of Los Angeles, where it is erecting a large refinery plant.

The Union Oil Co. markets, besides its own product, that of the Independent Producers Agency. The latter has a pipe-line system connecting the San Joaquin valley with Avila, on the coast in San Luis Obispo county. The Union has several pipe-lines connecting the Santa Maria fields, the Ventura county fields, and the Southern California fields with the coast. This company has a large fleet of tank-vessels and barges.

The Associated Oil Co. has entered into a contract with the Union Oil Co. and the Independent Producers Agency to market their surplus oil, existing business and the renewal thereof to remain with the Union, as also the exclusive right to make sales on the west coast of America. The Associated Oil has a pipe-line from the Kern River field to Port Costa, and one from Maricopa, through Midway, McKittrick, and Coalinga, to Port Costa; also another from Coalinga to the bay of Monterey. Further it has a pipe-line from the Santa Maria field to its refinery at Gaviota, in Santa Barbara county, and one from the Salt Lake field to Los Angeles.

The Independent Producers Agency is a combination of nearly all the producers in the San Joaquin valley outside of the above named companies, the Southern Pacific Railroad (Kern Trading & Oil Co.), the Santa Fe Railroad (Petroleum Development Co.), and a very few of the largest producers.

It is clearly to the interest of the Union Oil Co., the Associated Oil Co., and the Independent Producers Agency to maintain the price of oil. As to the railroads, both the Southern Pacific and the Santa Fe are endeavouring to have their production equal their consumption, and as it is of the greatest importance for them to have a permanent supply for the longest possible time, it is improbable that they will produce more than required for their own consumption, and hence the price of oil is a matter of little concern to them.

The World's Coal Resources. — The twelfth International Geological Congress is to be held in Toronto during the summer of 1912, and the attention of members is to be concentrated on a study of the world's resources of coal. Circulars have been despatched inviting assistance in the compilation of records of deposits both worked and unworked, and already the preparation of reports of the resources of every country has been taken in hand. It will be remembered that last year the iron resources were thoroughly discussed at the Stockholm Congress, and the literature then collected has been published in monumental volumes. At the time it was admitted that the consideration of the iron resources was incomplete without full information about fuel, and it was felt that coal demanded similar treatment.

WATER-BORNE PACKING FOR STOPE-FILLING

By EDGAR PAM.

THIS process, commonly known as 'sand-filling,' was started in Silesia in 1901, and its value has been proved by the rapidity with which it has been introduced all over the mining world.

The purpose is the strengthening of the mine workings, the support of the surface, the reinforcement of the shaft-pillars and the recovery of pillars, foot-wall, and broken rock, from abandoned workings. The application of this method must not be confounded with that of a few scattered waste 'packs' or 'sticks,' which, while efficiently supporting thin scales of hanging wall or purely local weight, are absolutely useless against a 'creep' or any serious subsidence.

Many collieries in Silesia, Westphalia, and France are employing this method of filling their workings; the majority of the mining groups on the Witwatersrand have adopted it, and from private information and current literature it appears that a large number of mines in Scotland and the United States are falling into line. Several accounts of the process as practised in collieries have been published recently, more especially in German periodicals, and this article will deal chiefly with the methods adapted to metalliferous mines, and used successfully in Johannesburg.

The general principles involved are:

Sand or gravel, together with any suitable refuse that may be at hand, is transported to some form of bin or flat sheet close to the shaft or borehole connected with the workings to be filled. Water is added under pressure and the resultant pulp is led through pipes or launders into a stope that has previously been prepared to receive it. The excess water is drawn off through the sand, and after settling is pumped to the surface for further use.

SURFACE ARRANGEMENTS. — In metalliferous mines the material used will almost invariably be tailing; in collieries, owing to an insufficient supply of waste products, it is often necessary to procure sand or gravel from some convenient deposit. Almost any sort of waste product can be used, but the efficiency of the pack will depend largely on the material of which it is composed. Clean quartz-sand sets well and after settlement crushes less than any other material. Experiments have shown that, under a pressure of 1500 lb. per square inch, its volume is only diminished by 3%. On the other hand, the wearing effect on pipes is most severe, and for this reason a small proportion of clay is often added. Clay by itself is not good, as it retains too much moisture and never sets. Ashes added to sand assist in the drain-

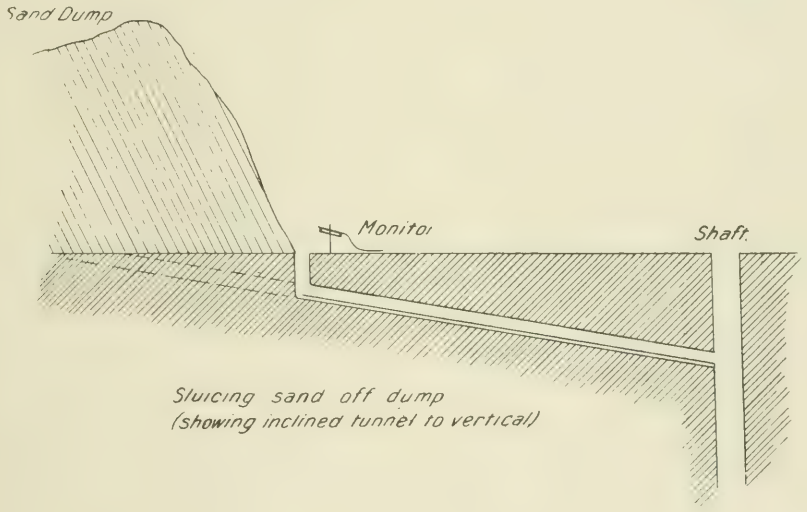


Fig. 1.

age of the water, but if used alone crush considerably under pressure.

On the Witwatersrand goldfield, where the removal of dumps or the prevention of their further growth is in itself a commendable object, only sand is used, taken either from the cyanide vats direct or conveyed from the nearest available dump. The use of current sand has the advantage of saving a second handling, but, on the other hand, some expense is incurred in oxidizing the cyanide compounds remaining in the sand, to prevent the formation of prussic acid underground.

After lying on a dump for some weeks, the sand is found to be quite free from cyanides, the atmosphere and sulphides having no doubt converted them into prussic acid, which has escaped into the air.

Where the quantity of current sand is insufficient for underground requirements, or where it is inconvenient to connect the cyanide works with a shaft, recourse is had to the alternative of conveying sand from the dump. This entails additional cost for shovelling, and, if the dumps be old and the sand acid, a considerable expenditure on lime to protect the pipes and pumps.

The method of transport depends, of course, on local conditions; for long distances a mechanical haulage is found best; for short distances a belt-conveyor or sand-pump, with subsequent dewatering, is used; and where the dump is quite close to the entrance to the mine, it is obviously cheapest to hydraulic the sand directly from the dump to the shaft or outcrop.

This last method can be extended with advantage where large-scale filling is to be continued for a considerable period by driving an inclined tunnel from under the dump or cyanide vats to intersect a vertical shaft some distance from the surface (Fig. 1). In this case the sand can be sluiced from the vats or the dump, and run down the tunnel in a launder, the cost of surface transport being almost negligible. When a dry method of transport is used, such as mechanical haulage or belt, some form of bin must be built near the shaft, the main features of which would be that it has large storage capacity, so that loading and discharging are not immediately interdependent, and that it can be discharged easily with water, so as to give a thick pulp.

A good form consists of a brick-lined excavation, 40 ft. long, 30 ft. deep and 12 ft. wide, with a capacity of 500 to 600 tons (Fig. 2). The bottom of the bin is built with a 30% fall towards a brick partition, on the other side of which is a tunnel from which the flow of sand and water is controlled through the partition wall; four openings (24 in. high and 12 in. wide) are left in the brick-work, and into these the sluicing nozzles project. The opening in the nozzles is 2 in. by $\frac{1}{4}$ in. and water is fed under 50 lb. pressure. The pulp flows back round the nozzles and drops into a launder running with a fall of 20% to the shaft or borehole.

Working with a bin of this description, it is possible to lower sand at the rate of 200 to 300 tons per hour, the pulp containing 65% of sand by weight. Other forms of bin could of course be devised. One consisting of a V-shaped hopper, inclined at 35°, is at present under trial. This has a capacity of 1000 tons, and the sand is sluiced off with monitors.

Pipes and Launders.—Where the flow of the pulp lies in a straight line and at an even dip of 12° to 35°, concrete-lined launders have been found satisfactory, but they do not provide the same elastic service as pipes, which can be bent and laid at any angle, either horizontal or vertical.

The head gained in vertical and steeply inclined sections of a pipe-line is used to overcome the friction of horizontal or even slightly rising sections, whereas launders overflow at any grade less than 10%. Pipes have, however, the disadvantage of being liable to choke, and are subject to enormous wear, with subsequent big expense.

Choking can be prevented almost entirely by avoiding sudden bends in the line, by washing out the pipes before and after use, and by using grills above the entrance to the pipe. The difficulty of excessive wear is unfortunately not so easily overcome, but a longer life is secured in horizontal and inclined sections by turning the pipes at intervals. In the case of vertical shafts, however, every possible form of pipe and pipe-lining has been tried, with but indifferent success.

An ordinary 4 in. black pipe in a vertical shaft 1100 ft. deep showed signs of wear after 20,000 tons of sand had been passed through it, when it was found necessary to patch a number of lengths. The average wear of a length proved to be about 30,000 tons, and some of the piping was good enough to be used again when a new line was put in.

A 7 in. pipe, lined to five inches with hard wood, resisted the passage of 32,000 tons of sand before leaking; but taking into consideration the cost of this piping, it is less economical than the unlined column mentioned above.

Porcelain-lined pipes, which have proved so

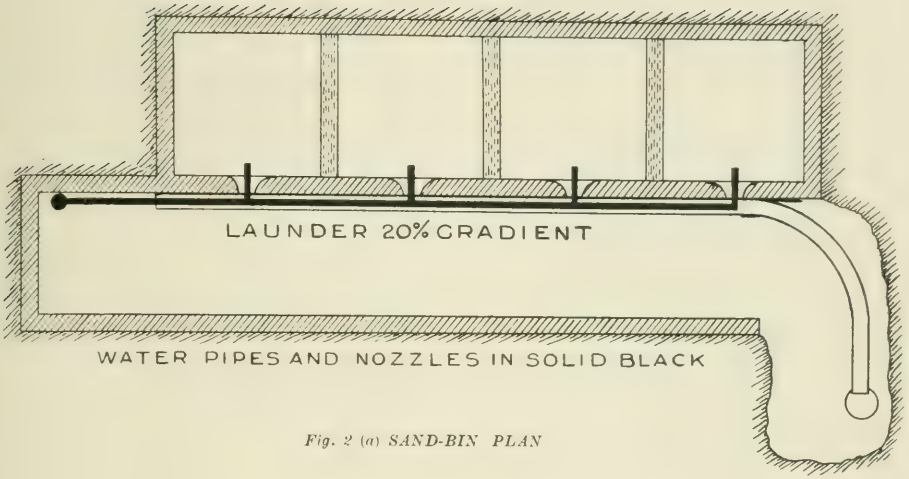


Fig. 2 (a) SAND-BIN PLAN

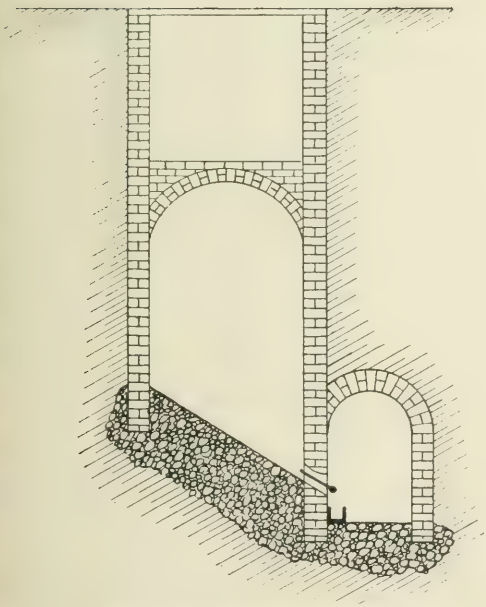


Fig. 2 (b) Sand-Bin, End Elevation.

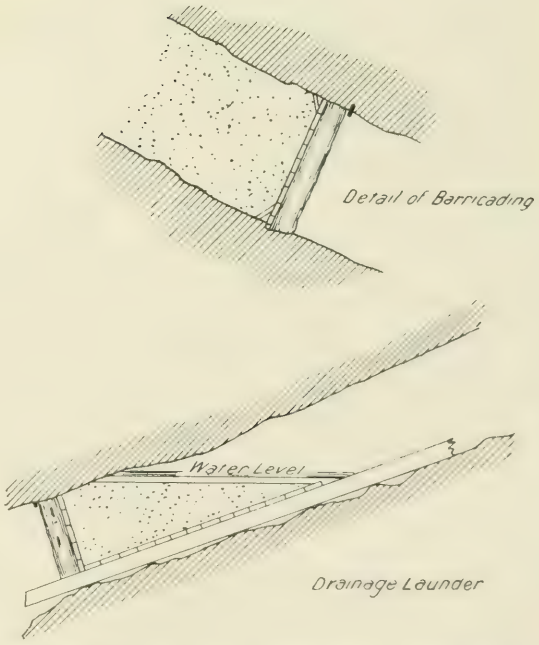


Fig. 3 (b and c) Details of Reinforcement of Shaft-Pillar.

successful in Germany, are now under trial in the same shaft, but have up to date not been used long enough to establish a conclusive test. Experiments are now being made with liners of concrete, belting, earthenware, and wood pulp.

Since, however, in other vertical shafts of less depth, the rate of wear has been found to be very much smaller, it has been decided in future to break the pipe every 200 or 250 ft., and to insert a box with the purpose of checking the velocity of the stream. The last 300 ft. of piping in the shaft will be left intact, in order to obtain sufficient head to force the pulp along a horizontal drift to a point 900 ft. from the bottom of the shaft, experiment having proved that if the ratio of horizontal to vertical pipe is greater than 3 : 1, it is necessary to dilute the pulp with more water, with a corresponding increase in the pumping cost.

It is impossible to give an opinion as to whether boreholes will prove economical as compared with vertical pipes for filling purposes, since but one borehole, and that only 180 ft. deep, has been used in this country, but the more obvious advantages and drawbacks may be outlined.

The main advantage of a borehole is that wear is of no moment, and there can be no expense for repairs or renewal on this account. Secondly, as the sand is not conveyed in the shaft, the nuisance of any spill caused by leakage does not exist.

The disadvantages, although individually not serious, collectively make the extensive use of boreholes very doubtful. The original outlay is great, being about five times the cost of piping of similar size. The delay due to the time taken in drilling is a serious drawback if there is a necessity for immediate filling. There is a possibility of the sand eroding any soft strata through which the hole passes, making a cavity, and allowing the strata above to fall in and choke the hole. It is more difficult to clean out a borehole that is choked than a pipe in the same state. For the last-named reason, a borehole is usually left open at the bottom, and the advantage of the head of sand due to the vertical depth is lost.

Underground Work.—The method of conveying sand underground is the same as that for conveying water.

Loose-flanged piping should be used if possible, to facilitate the turning of individual lengths; the joints must be good and there should be as few bends as possible in the line. Where practicable the piping should be on a down grade, and it may even be advisable to sink a special winze in order to avoid an excess of horizontal or rising pipes.

Barricading is the most important part of the underground work, and requires considerable care and experience. Fig. 3 shows a small area to be filled next to a shaft-pillar which is showing signs of pressure; the stope is 6 ft. high and dipping at 30°. Round sticks 10 to 12 in. diam. are lined up at 4-ft. intervals, well hitched into the foot-wall, and either hitched or pegged in the hanging wall. On to these are nailed 1½ in. deals, carefully butted against one another, and cut so that they join in the middle of an upright. The joint between the timber and the hanging wall, foot-wall or pillar, must be made most carefully; the deals are checked to fit the unevenness of the rock and hammered down on to the solid. Any crevices still showing are caulked with sacking, straw, or oakum, which is held in place by small pieces of wood laid on a bevel. If the work is done well, after a few hours no sand or slime, but only a little clean water, will come through the barricade.

Clay and cement have been tried in place of caulking, but are not successful, as the former washes away and the latter is too rigid. Where the stope is high, say 20 ft., a waste pack faced with cement is sometimes used as a bottom barricade. If the material used for packing is coarse, a rough waste pack covered with filter matting may be used with success, but when slime is present, the pores of the matting become choked and impervious to water; the weight of the pulp forces the matting into the crevices between the rocks, and the matting is torn and allows the pulp to come through.

For side barricades, any of the methods mentioned above may be used. When filling only small quantities, the sand itself may be thrown up to form a wall in the same way as is usual in building a slime-dam. The sand should, where possible, be led into a stope at the side where the barricade is least strong, as the coarse sand settles first and exerts less pressure than the slime.

Where a large section of a mine is caving and is to be held up to support the surface or to stop movement in the shafts, a different procedure is adopted.

In Fig. 4 almost all the stoped area is to be filled, every other consideration being neglected in order to ensure the safety of the mine. In this case there are no side barricades and the area to be supported at the bottom is small.

Under these circumstances no expense

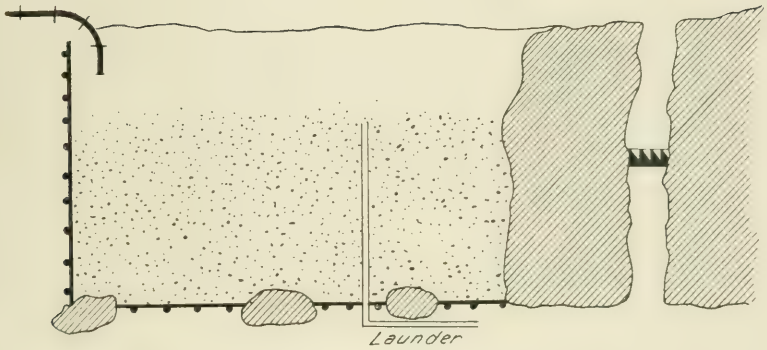


Fig. 3 (a). REINFORCEMENT OF SHAFT PILLAR.

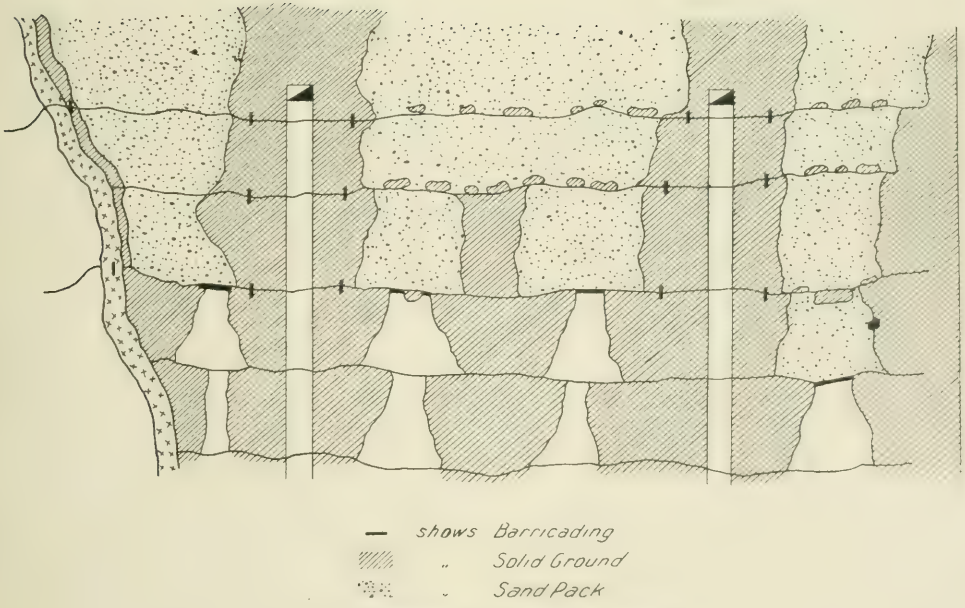


Fig. 4. FILLING ON A LARGE SCALE.

would be spared in making the barricade and dams quite secure; the uprights would be 15 in. or more, and the deals either 3 in. or two thicknesses of 1½ in. The dams across the drifts would be masonry, or, if there were any local movement, pitch-pine blocks three feet long, tapered from 12 by 12 to 10 by 10, would be preferable. In a case of this sort filling could be carried on from two plants, double-shift, and 100,000 tons could be lowered every month. With regard to pillars and blocks of ground left standing, these would be recovered after the sand had drained, by opening up the drifts and rising to the required spot.

Such a method of filling might delay the working of this remaining ground for a year or more, but the whole of it would be removed with safety, and in addition to attaining the desired object, an actual profit might be made from pillars that could never be recovered otherwise.

The drainage of the sand is of great importance, and can be arranged in several ways. The usual method is to carry a launder through a barricaded boxhole up the stope, and to close it with slats as the sand rises. The launder is placed as far as possible from the point where the pulp enters the stope, so that by the time the water reaches it, most of the sand has settled. In cases where the ground to be filled is so caved that it would be expensive to make a way for the launder, a filter is laid just inside the barricade; this is composed of several 2-in. pipes perforated with ⅛in. holes and covered first with coarse rock, then smaller pieces, and finally ashes. The total filter bed is about four feet thick and acts successfully.

From the sand-pack the water is led into settling-sumps built in old stopes, and escapes finally over a long horizontal overflow weir to the main sump.

In discussing the instalment of a plant for this method of supporting a mine, the effect of the following local conditions must be taken into account: In the case of steeply inclined lodes, the barricade must be built stronger than described above. When a small quantity of water is flowing from the hanging wall or foot-wall of a stope to be filled, it must either be isolated and piped through the sand or a large filter-bed must be laid at the bottom of the stope.

The process cannot be recommended for areas in which large quantities of water are appearing, unless natural boundaries, such as dikes or pillars, can be used in place of barricades. Under normal circumstances, as described in this article, the barricade can be pulled down six months after filling is completed, and the sand will be found to remain standing vertically in a hard compact mass.

Most of the leading mining engineers in Johannesburg have inspected the process, and they are almost unanimous in agreeing that it is fulfilling the claims made for it, and will prove of great value on the Witwatersrand.

The output of minerals and metals throughout the world during 1909 forms the subject of a Government publication issued at the end of September. The figures are belated, but as the strength of a chain is that of the weakest link, so is the completion of world's statistics delayed by the unenterprising states and countries. The total value of the output is estimated at £865,000,000, of which coal represented £400,000,000. The output of coal throughout the world was 1,113,308,386 tons, of which 268,007,257 tons was mined in the British Isles, 37,751,869 tons elsewhere in the British Empire, 418,038,117 tons in the United States, 217,445,656 tons in Germany, 48,812,901 tons in Austria-Hungary, 37,840,086 tons in France, 24,455,340 tons in Russia, and 23,517,550 tons in Belguim. Over 6 million people were employed in mining and of these more than half are at the coal mines. As regards petroleum, India yielded 938,466 tons and Canada 57,549. These are the only productions reported throughout the British Empire. The figures for the rest of the world were 38,992,088 tons of which 24,288,756 tons were produced in the United States, 8,435,072 tons in Russia, 2,088,931 tons in Austria-Hungary, 2,012,898 tons in the Dutch East Indies, and the remainder in smaller quantities in Roumania, Mexico, Japan, Germany, and Peru. The output of metals is calculated as the amount extracted from the ores mined in each country and not the production in each country from domestic and imported ores. In Great Britain the yield of iron was 4,879,226 tons, and in the rest of the British Empire 706,843 tons, of which nearly the whole is credited to Newfoundland and Canada. The rest of the world produced 52,822,822 tons, of which the United States accounted for 26,209,678 tons, Germany 7,098,470 tons, Spain 4,315,600 tons, France 4,205,489 tons, Russia 2,622,419 tons, Sweden 2,382,540 tons, Luxemburg 2,085,806 tons, Austria-Hungary 1,910,000 tons, and eleven other countries smaller quantities, Cuba, Algeria, Italy, and Greece being the most important.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Nipissing.

The Editor:

Sir—The story of the original purchase of the Nipissing, as told on page 94 of the August issue of *The Mining Magazine*, is interesting, but it lacks the essential element of truth. As years pass and men's memories become dim, fantastic tales are told of the discovery of important mineral deposits and the rise of mineral industries. We are told, for instance, that a certain prospector, in order to learn the location of a rich vein discovered by an Indian tribe, married the daughter of the chief. Another prospector is stated to have made an important find through throwing his hammer at one of the shyest of animals, a fox. In going to pick up the hammer, he found it lying on a valuable orebody. Again, one of the discoverers of corundum in Ontario is said to have made the find in the winter. He was wearing deer-skin moccasins and felt the rough surface of the corundum rock through the snow!

I think the following notes and copies of correspondence will make clear how Mr. E. P. Earle came to purchase the Nipissing mine.

In November 1903 I received a sample of ore in Toronto from Haileybury. This sample was niccolite (kupfer-nickel), which the finder thought was copper ore. A few days later I visited the locality and saw the remarkable assemblage of minerals in the veins that has been frequently described. On my return to Toronto I wrote a paper for the *Engineering and Mining Journal* of New York, published on December 10, 1903. This paper was later re-published in the *Canadian Mining Review*. It was also re-printed as a pamphlet, and copies of the pamphlet were sent to persons throughout the world who, I thought, might be interested in the ores. At that time Mr. Earle had an advertisement in the *Engineering and Mining Journal* to the effect that he was a purchaser of rare minerals. A copy of the pamphlet was sent to him. The result was that Mr. Earle wrote the following letter to me:

"29 Liberty St.,
New York,
January 30, 1904.

"Dear Sir—I am in receipt of your paper on the subject of cobalt-nickel ores in Ontario, and have read the same with much interest. In the last paragraph of your paper I note that you are willing to put buyers of cobalt ores in communication with producers. I make a specialty of rare minerals and am always in the market for cobalt ores, and will be greatly obliged if you will be kind enough to give me the names of some of the more important producers of the mineral.

Thanking you in advance for your attention,
I remain,
Yours very truly,
E. P. EARLE."

The following is a copy of my letter to Mr. Earle:

"Bureau of Mines,
Toronto,
February 4, 1904.

"Dear Sir—I am in receipt of your letter of January 30. Messrs. A. Ferland and W. C. Chambers, whose address is Haileybury, Ontario, are mining the cobalt ores to which you refer. You might write to them as to quantity which they can supply, etc.

I shall be pleased to give you further information at any time on this subject.

Yours very truly,
W. G. MILLER.
Provincial Geologist."

The gentlemen whose names I gave to Mr. Earle in this letter were two out of the five original owners of the Nipissing, the others being W. B. Russell, R. K. Russell, and R. Galbraith. Later on Mr. Earle visited Haileybury and Cobalt. The purchase of the property was, however, not completed until the autumn of 1904. The original owners had some prospecting done during the summer but did not discover any veins. Two had been found on the property in 1903.

W. G. MILLER.

Toronto, August 30.

Speculation in Mining.

The Editor:

Sir—The discussion in *The Mining Magazine* on the speculative character of the mining business is not entirely new, as witness the following from George Agricola, De Re Metallica, Book I., Basel, 1556.

H. C. HOOVER.

London, September 7.

"Since there has always been the greatest disagreement amongst men concerning metals and mining, some praising, others utterly condemning them, I have decided that before imparting my instruction I should carefully weigh the facts with a view to discovering the truth in this matter.

So I may begin with the question of utility, which is a two-fold one, for either it may be asked whether the art of mining is really pro-

fitable or not to those who are engaged in it, or whether it is useful or not to the rest of mankind. Those who think mining of no advantage to the men who follow the occupation, assert, first, that scarcely one in a hundred who dig metals or other such things derive profit therefrom, and again, that miners, because they entrust their certain and well-established wealth to dubious and slippery fortune generally deceive themselves, and, as a result, impoverished by expenses and losses, in the end spend the most bitter and most miserable of lives. But persons who hold these views do not perceive how much a learned and experienced miner differs from one ignorant and unskilled in the art. The latter without any careful discrimination digs out the ore, while the former first assays and proves it, and when he finds the veins either too narrow and hard, or too wide and soft, he infers therefrom that these cannot be mined profitably, and so works only the approved ones. What wonder then if we find the incompetent miner suffers loss, while the competent one is rewarded by an abundant return from his mining ? The same thing applies to husbandmen. For those who cultivate land which is alike arid, heavy, and barren, and in which they sow seeds, do not make so great a harvest as those who cultivate a fertile and mellow soil and sow their grain in that. And since by far the greater number of miners are unskilled rather than skilled in the art, it follows that mining is a profitable occupation to very few men, and a source of loss to many more. Therefore the mass of miners who are quite unskilled and ignorant in the knowledge of veins often lose both time and trouble. Such men are accustomed for the most part to take to mining when either through being weighted with the fetters of large and heavy debts they have abandoned their ordinary business, or in a desire to change their occupation have left the reaping-hook and plough. And so if at any time such a man discover rich veins, or other abounding mining produce, this occurs more by good luck than through any knowledge on his part.

* * * *

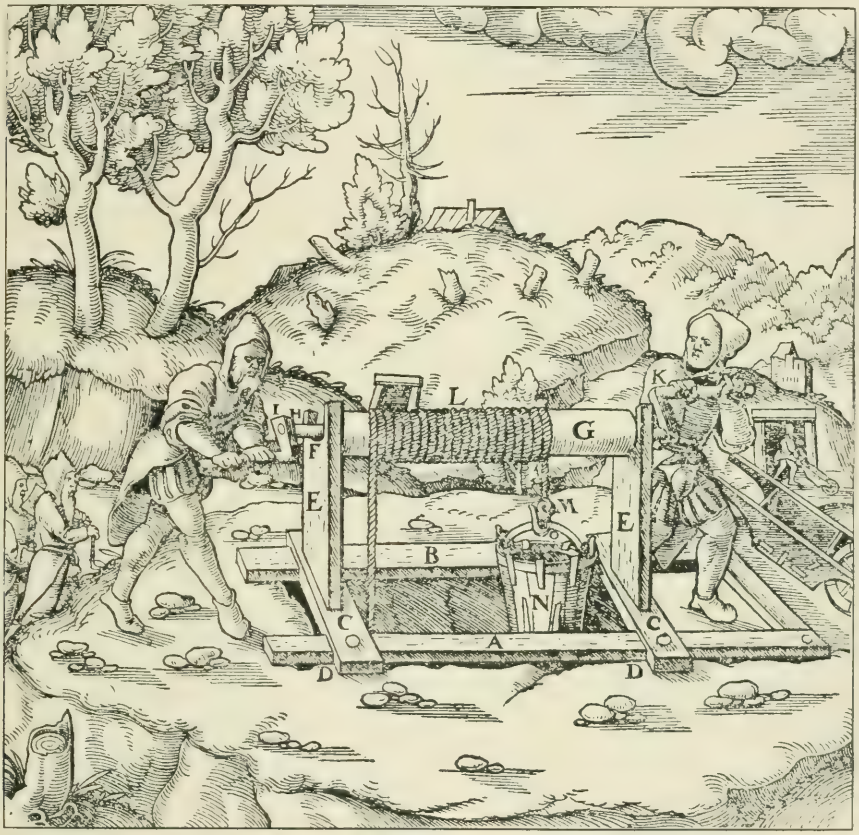
Again, those who condemn the mining industry say that it is not in the least stable, and they glorify agriculture beyond measure. But I do not see how they can say this with truth, for the silver mines at Freiberg and Meissen remain still unexhausted after 400 years, and the lead mines of Goslar, after 600 years. The proof of this can be found in the monuments of history. The gold and silver mines belonging to the communities of Schemnitz and Cremnitz have been worked for 800 years, and these latter are said to be the most ancient privileges of the inhabitants. Some also say the profit from an individual mine is unstable, and if, forsooth, the miner is, or ought to be dependent on only one mine, and as if many men do not bear in common their expenses in mining, or as if one experienced in his art does not dig another vein if fortune does not amply respond to his prayers in the first case. The New Schönberg at Freiberg has remained stable beyond the memory of man.

It is not my intention to detract anything from the dignity of agriculture, and that the profits of mining are less stable, I will always and readily admit, for the veins do in time cease to yield metals, whereas the fields bring forth fruits every year. But though the business of mining may be less reliable, it is more productive, so that in reckoning up what it is wanting in stability is found to be made up by productiveness. Indeed, the yearly profit of a lead mine, in comparison with the fruitfulness of the best fields, is three times or at least twice as great.

* * * *

The following are some of the wicked and sinful methods by which they say men obtain riches from mining. When a prospect of obtaining metals shows itself in a mine, they contend that either the ruler or magistrate drives out the rightful owners of the mines from possession, or a shrewd and cunning neighbour perhaps brings a law-suit against the old possessors in order to rob them of some part of their property. Or the mine superintendent imposes on the owners such a heavy contribution on shares that if they cannot or will not pay, they lose their rights of possession, while the superintendent, contrary to all that is right, seizes upon all that they have lost. Or, finally, the mine foreman may conceal the vein by plastering over that part where the metal abounds, with clay, or by covering it with earth, stones, stakes, or poles, in the hope that after several years the proprietors, thinking the mine exhausted, will abandon it, and the foreman can then excavate that remainder of the ore and keep it for himself. They even state that the scum of the miners exist wholly by fraud, deceit, and lying. For to speak of nothing else, but only of those deceits which are practised in buying and selling shares, it is said they either advertise the veins with false and imaginary praises, so that they can sell the shares in the mines at one-half more than they are worth, or on the contrary, they sometimes detract from the estimate of them

so that they can buy shares for a small price. By exposing such frauds our critics suppose all good opinion of miners is lost. Now, all wealth, whether it has been gained by good or evil means, is liable by some adverse chance to vanish away. It decays and is dissipated by the fault and carelessness of the owner, since he loses it through laziness and neglect, or wastes and squanders it in luxuries, or he consumes and exhausts it in gifts, or he dissipates and throws it away in gambling.



AN ILLUSTRATION FROM AGRICOLA.

* * * *

The mine superintendent cannot exact calls from the owners without the knowledge and permission of the Bergmeister or the Deputies. For this reason deception of this kind is impossible. Should the foremen be convicted of fraud, they are beaten with rods; or of theft, they are hanged. It is complained that some sellers and buyers of the shares in mines are fraudulent. I concede it. But can they deceive anyone except a stupid, careless man, unskilled in mining matters? Indeed, a wise and prudent man, skilled in this art, if he doubts the trustworthiness of a seller or buyer, goes at once to the mine himself that he may for himself examine the vein which has been so greatly praised or disparaged, and may consider whether he will buy or sell the shares or not. But people say, though such an one can be on his guard against fraud, yet a simple man and one who is easily credulous is deceived. But we frequently see a man who is trying to mislead another in this way deceive himself, and deservedly become a laughing-stock for everyone. For very often the defaulter as well as the dupe is entirely ignorant of mining. If, for instance, a vein has been found to be abundant in ore, contrary to the idea of the would-be deceiver, then he who was to have been cheated gets a profit, and he who has been the deceiver loses. Nevertheless, the miners themselves rarely buy or sell shares, but generally they have *jurati venditores* (brokers?) who buy and sell at such prices as they have been instructed to give or accept.

* * * *

But to bring this discussion to an end, inasmuch as the chief callings are those of the moneylender, the soldier, the merchant, the farmer, and the miner, I say that inasmuch as usury is odious, while the spoil cruelly captured from the possessions of the people innocent of wrong is wicked in the sight of God and man, and inasmuch as the calling of the miner excels in honour and dignity that of the merchant trading for lucre, while it is not less noble though far more profitable than agriculture, who can fail to realize that mining is a calling of peculiar dignity ? Certainly, though it is but one of important and excellent methods of acquiring wealth in an honourable way, a careful and diligent man can attain this result in no easier way than by mining."

Ball-Mill Practice.

The Editor:

Sir—I have read with great interest the valuable contribution of Mr. M. W. von Bernewitz in your August issue. Metallurgists will agree that Kalgoorlie practice is, as far as dry crushing with ball-mills is concerned, far ahead of other districts in efficiency and low working costs.

In my opinion we have not yet had sufficient proof that wet-crushing ball-mills are as efficient as heavy gravity stamps on hard dense ores, although they show to advantage when compared with light gravity stamps and would probably compare favourably with the heavy stamp on soft friable ores. I take it that the heavy stamp is suitable for hard ores, not soft ones.

On page 81 of Warnford Lock's 'Gold Milling' the author states that a Krupp mill had a greater output than a 10-stamp battery, but does not give details.

The following is an instance of a No. 5 Krupp wet-crushing ball-mill working on hard dense quartz in comparison with light gravity stamps. In the third column I have put the output of the Simmer Deep-Jupiter mill, having taken the data from Caldecott's paper on heavy gravity stamps in Vol. XIX of the Transactions of the Institution of Mining and Metallurgy.

I should not like to contract to erect a No. 5 ball-mill in 24 hours with 28 men, for to my mind the building of a ball-mill is not so easy as the author would lead one to believe. He reminds me of the miner's wife whose husband was grumbling about going to work on the first shift of the week at night. The good lady remarked: "Why there is only to-night, to-morrow night, the night after that, and three more nights, and you are finished."

DONALD F. FOSTER.

Parral, Mexico, September 7.

	Ball-mill	Light Gravity Stamps	Simmer Deep-Jupiter Heavy Stamp
Weight of Balls or Stamps	1000 kilo 2200 lb.	10 of 850 lb. 5 of 750 lb.	1600 lb.
Drop in Inches	4	6	8
Screen Aperture	0·0312	0·0312	0·028
Revolutions or Drops per minute	24	102	96
Tonnage per 24 hours	30	30	8·31
Grading:			
On 30 mesh %	33·4	—	—
„ 40 „ „	11·8	—	—
„ 60 „ „	19·9	—	31·7
„ 80 „ „	7·8	—	—
„ 90 „ „	—	—	16·5
Through 90 „ „	—	—	51·8
On 100 „ „	1·0	—	—
„ 150 „ „	0·6	—	—
Through 150 „ „	25·5	—	—

Most Productive Gold Mine.

The Editor:

Sir—Being in a somewhat critical mood when I took up your August issue, I noted in the editorials two statements to which I take exception. The more important is on page 101, where you refer to the Crown Mines as "forming the most productive gold mining property in the world," and state that the net profit for the first half of 1911 was the equivalent of about $3,000,000. The term 'productive,' as used here, is not definite. Assuming that you mean productive to shareholders, I

would call your attention to the enclosed clipping anent the production—net profit—of the Goldfield Consolidated Mines for the same period. You will note that the net profit reaches the magnificent total of $4,240,754, over 40% greater than the net profit of the Crown Mines. During the first half of 1911 this company distributed $3,558,367 in dividends. The Rand amalgamation does not yet deserve the palm.

Having read many of Claude T. Rice's articles with much profit, I was amazed at your attack on him on page 96. In that editorial you lead your readers to infer that his writings are not trustworthy because of his connection with the campaign of *Mines and Methods* against Utah Copper. A perusal of the columns of the *Engineering and Mining Journal* would show Mr. Rice to be one of its frequent contributors. His connection with *Mines and Methods* was severed nearly a year and a half ago, that is, in May 1910, as *Mines and Methods* announces in its issue of August 1910. In a later number, not now at hand, that paper assails Mr. Rice himself, while admitting that he had had no connection with its assaults on Utah Copper.

L. O. H.

Cleveland, Ohio, September 14.

[We are always willing to publish corrections or views contrary to our own. We were not aware that Mr. Rice left *Mines and Methods* so long ago. He has transferred his services to various periodicals four times within four years, so that our error is pardonable. Our correspondent, however, is quite mistaken in suggesting that Mr. Rice had "no connection with the assaults on Utah Copper" to which we referred. He not only attacked the Utah Copper company but maintained a vendetta against Mr. D. C. Jackling, the manager of that company.—EDITOR.]

Slime Settlement.

The Editor:

Sir—My eye has caught the précis of an article on slime settlement as it appears in your issue of August, on page 149. Mr. B. L. Gardner is quite wrong in claiming novelty for the device. I adapted it to slime settlement at Concheño some 14 years ago, and Mr. Robert H. Richards has given me full credit, describing and figuring it in his 'Ore Dressing,' Vol. 1, page 459. As it is a remarkable settler, and as I had the honour of introducing it into the mining field, I do not wish to lose credit therefor. As Mr. Gardner must be familiar with the great authority in English on ore dressing, I imagine he must have seen this in Richards' book and later have forgotten where he received the suggestion.

COURTENAY DEKALB.

Fundicion, Mexico, September 8.

Ventilation in Mines.

The Editor:

Sir—in your issue of May you do me the honour to review my paper on 'A Standard of Adequate Ventilation at Metal Mines' recently read before the Australasian Institute of Mining Engineers. In your review you consider some of the arguments advanced by me as reactionary. Will you kindly permit me to reply? One of two things must have happened; either I have not in my paper made myself sufficiently explicit, or you have imperfectly grasped the arguments I advanced.

Upon reference to the text of my paper, you will find that I said: "(*1*) That the volume constituting an adequate amount of air, within the meaning of the law, is not ascertainable by the rule-of-thumb formula of a quantity standard, but may only be found from the analysis and temperature of the mine air." Upon page 7 you will also find that I endorse the British regulation as regards adequate ventilation, and that I state that successive Royal Commissions have approved of it and have left it unaltered. This regulation is as follows: "An adequate amount of ventilation shall be constantly produced in every mine to dilute and render harmless noxious gases to such an extent that the working places, levels, stables, and workings of the mine and the travelling roads to and from those working places shall be in a fit state for working and passing therein." You will observe that no fixed standard is here given. In no place in my paper do I suggest the fixing by statute of a standard of ventilation, and nowhere in the report of the British Royal Commission on Mines 1909 is such a thing proposed.

Regarding the standard I was advocating, namely, a minimum of 19% by volume of oxygen and not more than $1\frac{1}{4}\%$ of CO_2, I specially stated that I did not suggest that these proportions should constitute a demarcation between adequate and inadequate ventilation, but rather as a readily detected standard (by its effect on lights) to be used by inspectors and others who may require information of the state of the air in a mine, this to be followed by analysis if necessary. The whole tenor of my paper was against a fixed standard that can not always be maintained, but rather in advocacy of a practical standard

that would be regarded as reasonable by those familiar with mining conditions.

From experience gained as an Inspector of Mines both in Australia and New Zealand, I can affirm that if one section of a mining statute is so weak as to permit disregard, there will certainly be other sections with regard to which mine officials will request equal clemency, and, in common with Dr. Haldane and Professor Cadman, I believe that the British Factories Standard of CO_2, namely, 25 parts by volume in 10,000 parts of air, to be unnecessarily strict for mines, giving my reasons for such an opinion. In the most adequately ventilated metal mines conditions may arise where such a standard would be unattainable except at considerable cost and after harassing delay, for example in rises, crosscuts, or 'dead' ends approaching other working places, when for a brief period the air is more or less heated and vitiated, especially after blasting. If the strict standard suggested in your leading article were here enforced, it would usually be necessary to stop work to install a supplementary mechanical ventilator adjacent to the place, although possibly a few feet of drift would connect with other places and give an air-circuit. In Great Britain, New Zealand, and New South Wales, where the law gives the inspector some latitude, that official would use his discretion in deciding what should be "adequate ventilation" under mining conditions. Here in New Zealand such an officer inspects the mine throughout frequently, and being equipped with anemometer, hygrometer, and sample bottles, he quickly settles such questions, and by regulation he may constitute any indifferently ventilated part of a mine a 'six hours place,' that is, where six hours shall be paid for as full time, although the recognized day is of 8 hours duration. If the deadly carbon monoxide in appreciable quantities appeared in any part of a mine, and this would be readily determined from the regular analysis of mine air taken by all Inspectors, then the action of the inspector would be drastic, as these would constitute a breach of that part of the regulation which specifies that noxious gases should be diluted and rendered harmless.

As regards the presence of CO in metal mines, during shovelling after blasting no doubt this poisonous gas may be found in minute quantities by analysis. Here in New Zealand such quantities have been inappreciable owing no doubt to the almost universal use of mechanical ventilation, but in Western Australia rather more CO has been detected. In a recent 'Report on Investigations into the Composition of the Gases caused by Blasting in Mines' by E. A. Mann, Chief Inspector of Explosives, Western Australia, 1911, a table is presented which states the percentage (by volume) of CO in samples of mine air taken during the shovelling of ground broken by blasts of gelignite in Australian metal mines. Forty samples were taken under these conditions, which may be regarded as the most favourable working conditions for obtaining good air, yet the percentage of CO was found to range from 0·0001 to 0·0082, which, according to the highest British authority (Dr. Haldane), is not productive of noticeable symptoms. Dr. Haldane stated in his recent lecture before the Midland Institute of Engineers at Nottingham, that these symptoms were never produced with less than 0·02% CO, since absorption ceased when the blood became saturated to a comparatively slight extent. It is not inferred that greater percentages of CO may not be found in smoke immediately following blasting, but men are not called upon to work in such an atmosphere. The object of my paper and this letter is to suggest a workable standard of adequate ventilation.

FRANK REED.

Wellington, N.Z., July 12.

[We agree that faulty ventilation may be allowable under the special circumstances mentioned, but the general impression given by Mr. Reed in the paper quoted by us in our May issue was that he considered the candle test good enough, and that he objected to the academical and harassing regulations adopted by various Colonial governments.—EDITOR.]

Malaria.

The Editor:

Sir—On reading, in the June number of *The Mining Magazine*, your editorial on malaria, I was reminded of a palliative for mosquito bites, namely menthol, the use of which I discovered accidentally a short time ago.

The use of menthol for the above purpose may be well known though I have never previously heard of it in this connection. There must be many who, like myself, have suffered torments from the bites of the various types of mosquito, sand-flies, and similar pests in places where the use of netting and oil are not practicable, and to any of these who have not tried the above remedy the information I give may be welcome.

STEPHEN J. LETT.

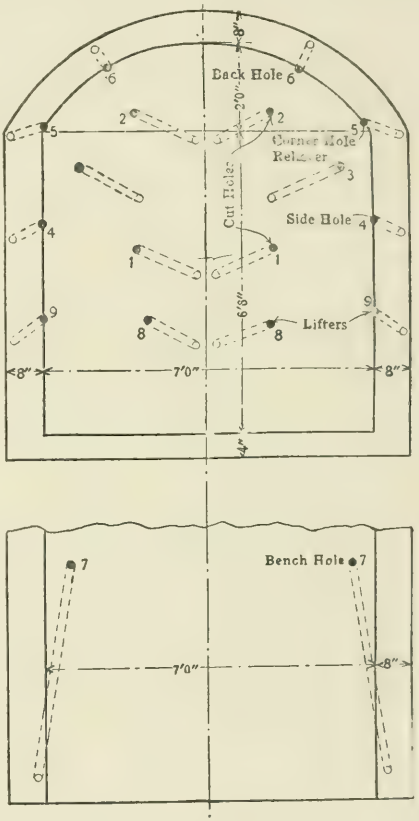
Tapianaveli, Sumatra, August 23.

PRÉCIS OF TECHNOLOGY

Zinc-Dust Precipitation.—In the *Engineering and Mining Journal* for August 26, C. W. Merrill gives some figures obtained from well-known mines, comparing the cost of precipitation of gold from cyanide solutions by zinc dust and zinc shavings respectively. Dust was tried years ago, but it failed to give satisfactory results, and was abandoned in favour of shavings. Mr. Merrill, however, revived its use by inventing suitable apparatus, and his method is adopted at most of the new plants in North America; besides which it is beginning to acquire a foothold in South Africa, five installations being now fitted with the apparatus. As regards results, at the Homestake, in South Dakota, the zinc consumed in precipitating exceedingly low-grade waste solutions was 0·17 lb. per ton of solution with shavings, and is 0·12 lb. with dust. Throughout the cyanide plant, which treats altogether 130,000 tons of ore per month, the consumption of dust is 0·1 lb. per ton. At the new plant of the La Blanca, at Pachuca, Mexico, the consumption of dust is 0·93 lb. per lb. of pure silver produced, and the precipitate as taken from the presses is 73 to 75% fine. At the new Santa Gertrudis plant in the same district, the consumption is 1·2 lb. per lb. of silver-gold bullion produced; the precipitate is 87% fine and the bullion 950 fine. The average obtained by the shaving process in Mexican plants is 1·5 lb. per lb. of fine metal, and the precipitate is 60 to 70%. In the El Oro district, in Mexico, there are three plants, two using shavings and one dust. The costs of precipitation at the first two are 15 and 10 cents respectively, while at No. 3 the cost is 8 cents. At the Goldfield Consolidated, Nevada, an additional advantage is gained; the solutions carry much copper which would plate and polarize shavings, but with dust, owing to fresh zinc being continually added, polarization is prevented.

Mr. Merrill proceeds to recapitulate some of the advantages of zinc-dust precipitation. One is that dust is 20% cheaper, a fact which is important in the treatment of silver ores. Another is that the process can be effected out of contact with air, thus removing the worry caused by re-solution. Thirdly, at each clean-up the whole of the precious metal can be removed, instead of anything up to 30% being carried continuously in the boxes from month to month Fourthly, the precipitate is collected in a heavy iron press, which acts as a safe, as a protection against theft and fire.

Tunnel Driving.—The *Mine and Quarry* for May contains an account of a great irrigation scheme now in course of completion, undertaken for the purpose of collecting water and carrying it 30 miles to a stretch of valuable agricultural land in Strawberry valley near Utah lake, about 60 miles south of Salt Lake City. The great engineering work in connection with this scheme was the piercing of an intermediate mountain range by means of a tunnel. The length of this tunnel when completed will be 19,000 ft., and the fall is 2 ft. per 1000. The higher or eastern end is 7500 ft. above the sea, and the crest of the mountain range is 1500 ft. above this. The cross-section of the tunnel is shown in the accompanying illustration. The excavated area is about 10 ft. high and 9 ft. 6 in. wide. After the concrete lining is inserted, the internal width will be 7 ft., and the height to the crown of the arch 8 ft. 6 in. The depth of the flowing water will be 6 ft. 6 in., the volicity will be 12 ft. per second, and the flow 500 cu. ft. per second. The driving was commenced in 1906, but at first many difficulties arose, and work was several times suspended. In the meantime a hydro-electric power plant was built, and in 1908 operations were re-commenced with electric drills. These were not satisfactory, and in 1909 Sullivan air-drills were substituted. Owing to the wet ground at the eastern or higher end, it has not been feasible to drive from that direction, as enormous pumping engines would have to be employed, and as the mountain is rocky and precipitous, no shaft could be sunk from which to drive at an intermediate station, and it has therefore been necessary to work entirely from the lower end. Before the Sullivan drills started, extensive diamond drilling was done with a view of ascertaining the nature

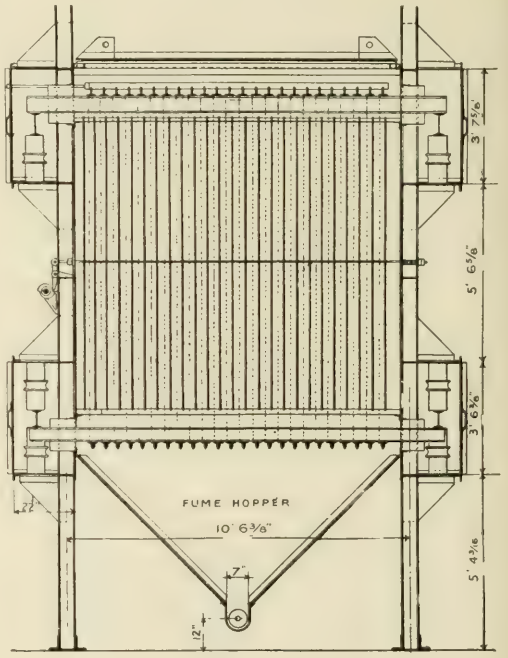


of the ground through which the tunnel would pass. In actual driving, the heading and bench method is used. Two drills are employed, and are mounted on two double-screw columns with adjustable arms. After each machine has finished its half of the drilling in the heading round, it is turned up on the arm and the holes for blasting the bench are then drilled. Thus the entire round of holes necessary for blasting across the tunnel is drilled in one shift. Usually 16 holes are drilled in the face and two in the bench. The cut holes are 7 ft. deep and the others, including those in the bench, about 6 ft. The heading is driven with a bench about 3 ft. high, which is carried from 10 to 12 ft. back of the face. The holes are exploded in the order shown in the diagram. The rock consists of alternate strata of hard sandstone and hard blue limestone, the latter predominating. During the 20 months from April 1909 to November 1910, the tunnel was advanced 7844 ft. or 392 ft. per month. The cost per foot is estimated at $26·70.

Eclipse Filter for Slime.—In the *Mining and Engineering Review* for August, M. W. Von Bernewitz describes a new filter called the 'Eclipse,' and invented by H. Wallace, that is being experimentally tested at the Associated Gold Mine, Kalgoorlie. A continuous travelling belt is arranged horizontally and passes round rollers at each end. It is made of rubber punched with holes and covered on the top side with filter-cloth. It is 3½ ft. wide and is jointed longitudinally along the middle so that it can be folded. In the centre part of the travel of the belt it passes between a set of vertical iron rollers and is folded, assuming a vertical position. The slime is fed into the V-shaped trough of the belt, and as the belt passes between the rollers it is trapped, and squeezed by the pressure of the rollers. The solution is thus expelled and caught in a trough below, while the cake, on emerging from the end rollers, is loosened from the belt as it opens flat once more and passes round the end horizontal roller. The first vertical rollers are flat on one side so that the contained slime can pass within the space between them without any squeezing action. As the rollers revolve, their cylindrical surfaces come opposite each other and bring the two parts of the belt into close contact. Arrangements are also provided to keep the upper edges of the belt close together while passing along the space between the first, second, and third sets of rollers where the squeezing takes place. A machine to handle 650 tons per day costs £150 to build, and requires 3 horse-power to drive. It is claimed that the continual movement of the belt prevents the accumulation of fine slime in its interstices. It is not easy to describe a machine without an illustration; unfortunately that appearing with the article is too indistinct for reproduction here.

Electrostatic Concentration of Zinc Ore.—The *Mining and Engineering World* (Chicago) for August 26 gives an account of the application of the Huff electrostatic separator to the complex zinc middling produced at the Calumet & Sonora Mining Co.'s mines at Cananea, Mexico, not far from the Greene-Cananea properties. The mines contain a mixed sulphide ore preponderating in galena and blende, and carrying varying proportions of pyrite and chalcopyrite. Silver is associated with the lead, and in places antimony and bismuth minerals are found. The gangue consists of calcite, quartz, and barite. The chief mine, the Chivera, is down 545 ft. The first owners attempted to recover the galena by jigging, but as this was a commercial failure, the new owners, advised by D. E. Woodbridge, consulting engineer, and J. N. Hauser, superintendent, reorganized the plant and erected Wilfleys and Deisters. By this means a 60% lead concentrate was obtained, with a middling averaging 30% zinc, 3½% lead, 7% copper, 15% iron, and 3 oz. silver. About 4500 tons of this material accumulated on the dump, and the addition was 15 tons per day. The new plant recently erected for its treatment consists of 10 Huff machines of various powers. The middling is sized to + 20, + 50, and − 50. A concentrate averaging 55% zinc, 1% copper, and 4% iron is obtained, with a recovery of 85% of the zinc. The remaining tailing is treated on tables and a saleable copper product obtained.

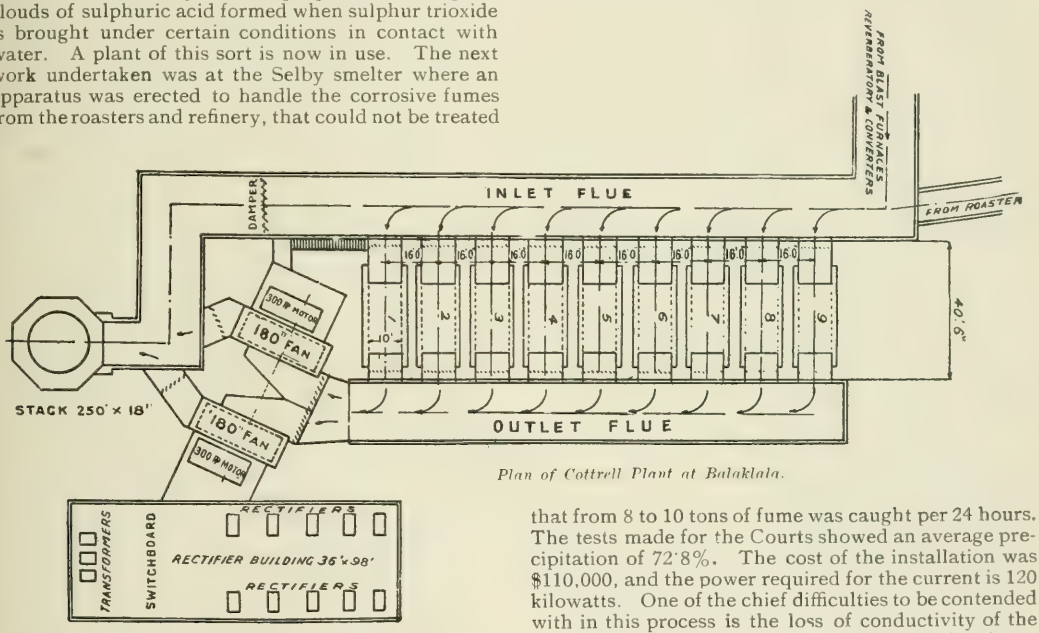
The experimental work on this middling was done at the Huff plant at Platteville, belonging to the American Zinc, Lead, and Smelting Co. The writer of the article states that in the experiments on the dump ore it was found that some of the copper had been leached and redeposited in a minute film upon the blende. This was sufficient to give the blende an electric characteristic too much like that of the pyrite and chalcopyrite, so that difficulty was experienced in getting a clean separation. In order to remove the copper, the middling was given a wash in weak cyanide. This experience led the chemists to apply the same principle in a different way, namely, to facilitate the separation of the blende from the gangue. After the removal of the iron-copper minerals in the first electrostatic machines, it had been found impracticable to remove the gangue from the blende by the Huff process. The experiment was therefore tried of treating the blende and gangue with copper sulphate, and thus to deposit copper on the blende. In this way the blende was made susceptible to the action of the magnets, and it could thus be separated from the gangue. More information on this point is desirable.



Section through Cottrell Settler.

Cottrell's Fume-Settler.—In our issue of May last we gave a short notice of the electrostatic fume-settler erected by F. C. Cottrell at the Balaklala smelter, California. The *Mining and Scientific Press* for August 26 and September 2 reprints a lengthy paper on the subject by Mr. Cottrell. This paper contains an interesting and valuable study of the philosophy and applications of this idea, and should be read in full. He first discusses the history of the many attempts to remove suspended particles from gases by means of electric discharges, beginning with Hohlfeld's experiments in connection with the suppression of ordinary smoke. He refers to the work in 1885 done by A. O. Walker and W. M. Hutchings at Bagillt, Flintshire, where discharges from Wimshurst machines were tried for the purpose of settling lead fume. All these earlier experiments had the disadvantage of working with primitive methods of obtaining electric discharges and fields. The modern high-potential direct-current dynamos, and more particularly the rectifiers used to adapt the current of alternators, have made it possible

to conduct experiments on a much larger scale. The principle of the electrostatic settler may be explained in a few words. If needle points connected with one side of a high-potential direct-current line are brought opposite a flat plate connected with the return line, the intervening space becomes charged with electricity of the same sign as the points, and any insulated body in this space is also charged in the same way. If these bodies are free to move, as in the case with dust, fume, or vapour, they will be repelled from the points toward the plate and will move at a rate proportional to its charge and the potential gradient between the points and the plate. If no solid or liquid particles are present, the same phenomenon is observed in connection with the air or gas, for a candle flame may be extinguished by bringing it near the points. After Mr. Cottrell had studied the problem in the laboratory, he tried it on a commercial scale at sulphuric acid works on San Francisco bay, for the purpose of settling the clouds of sulphuric acid formed when sulphur trioxide is brought under certain conditions in contact with water. A plant of this sort is now in use. The next work undertaken was at the Selby smelter where an apparatus was erected to handle the corrosive fumes from the roasters and refinery, that could not be treated



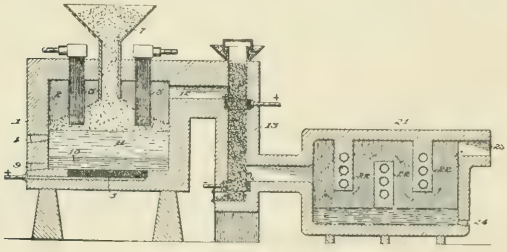
Plan of Cottrell Plant at Balaklala.

in the bag-house. The refinery gases were easily amenable to this treatment, and by its means the sulphuric acid has been recovered for the last three years. A plant was afterwards erected to treat the roaster fumes, and its operation satisfactorily determined, but owing to the fume litigation the further refitting and introduction of practical modifications has been suspended. The experience gained at these two works was applied to the erection in March 1910 of a larger plant to treat the whole of the gases at the Balaklala copper smelter at Coram, California. This gave encouraging results, but did not remove a large enough proportion of the fume and gases to appease the farmers and the Courts, so it has for the present gone out of use and the smelter is closed. A detailed description of the plant will nevertheless be of value. The capacity of the smelter is 700 to 1000 tons per day, and the ore averages 2½ to 3% copper. Most of the ore goes to the blast-furnaces, and the remainder to McDougal roasters and a reverberatory furnace. There is also a converter installation. The gases from all these furnaces go to a flue measuring 18 by 20 ft., and their volume varies from a quarter to half a million cubic feet per minute, the velocity being 10 to 20 ft. per second. The accompanying Fig. 1 gives a plan of the arrangement of the nine precipitation chambers, and Fig. 2 a section through one of them. The fans shown in Fig. 1 are scientifically unnecessary, but had to be installed so as to satisfy the farmers' requirements as regards sulphur dioxide, the maximum allowed by the Courts being ¾%. In the rectifier building the three-phase current at 2300 volts is stepped up to 25,000 volts and transformed into an intermittent direct current. In Fig. 2 the vertical lines represent the collecting or grounded electrodes made of iron sheets 10 ft. high, and the dotted lines show the discharge electrodes consisting of two iron-wire strands between which is twisted the asbestos and mica that form the discharge points. The tests on this plant showed that from 80 to 90% of the suspended matter was precipitated and that from 8 to 10 tons of fume was caught per 24 hours. The tests made for the Courts showed an average precipitation of 72·8%. The cost of the installation was $110,000, and the power required for the current is 120 kilowatts. One of the chief difficulties to be contended with in this process is the loss of conductivity of the mica and asbestos points. Moisture from the air accumulates on them, and in addition the zinc oxide in the fume is inimical to their conductivity. The author promises on a future occasion to tell more about the methods employed to preserve the conductivity.

Tin in Rhodesia.—Several discoveries of tin ore have been made in Rhodesia during the last year or two. We have already published descriptions of the occurrences in the Enterprise and Abercorn districts. In the *Rhodesian Mining Review* for August 16, R. C. H. Cooke describes the deposits quite recently discovered near Ndanga, 42 miles east of Victoria, which is 150 miles due east of Bulawayo. The formation carrying the tin-bearing dikes is a belt of dark close-grained epidiorite, running east and west, about 4 miles from a granite contact on the north and 6 miles from a similar contact on the south. Banded ironstone and schists are found in the intervening spaces, the latter being nearest the granite. The epidiorite shows fissures, filled by pegmatite dikes that have subsequently become greisenized. Mr. Cooke describes three of these dikes. Two strike across the formation and a third is parallel with it. The dike farthest west

is wide and is composed of a characteristic greisen containing lepidolite-mica, but does not, so far as prospected, show any tin. The next dike 200 ft. east has been followed for 1000 yards and varies from 10 to 20 ft. wide. It carries visible cassiterite over almost its entire outcrop, and in some places samples assayed 10% tin. It consists mainly of quartz with white and pale green mica, sericite and muscovite, and here and there hexagonal prisms of brown tourmaline. The cassiterite occurs in all sizes from minute particles to crystals an inch long. The dike has weathered well and stands prominently above the adjoining country in some places. The third dike cuts across No. 2 at its northerly end and is of similar constitution except that it contains no muscovite. Sampling gave over 2% tin. There is reason to believe that other tin-bearing dikes will be found, for one river-bed contains water-worn crystals of cassiterite that could not have originally come from those already known. No work has yet been done to prove the nature of the dikes in depth.

Johnson's Electric Zinc Furnace.—At the meeting of the American Electrochemical Society held in April, Joseph W. Richards read a paper describing an electric furnace, designed by W. Mc A. Johnson, for distilling zinc ores. The furnace on which the experimental work was done absorbed 25 kilowatts, and the results were so good that a larger one is now being built. Owing to the interest aroused in England by the purchase of the Swedish and Norwegian smelting works, as described in another paragraph in this 'Précis,' we reproduce the illustration of Mr. Johnson's furnace and quote Professor Richards' article. It will be seen that there are two movable positive electrodes, and one negative electrode embedded in the bottom of the furnace. The feed is continuous, the ore being introduced between the two positive electrodes. The heat is generated by the resistance

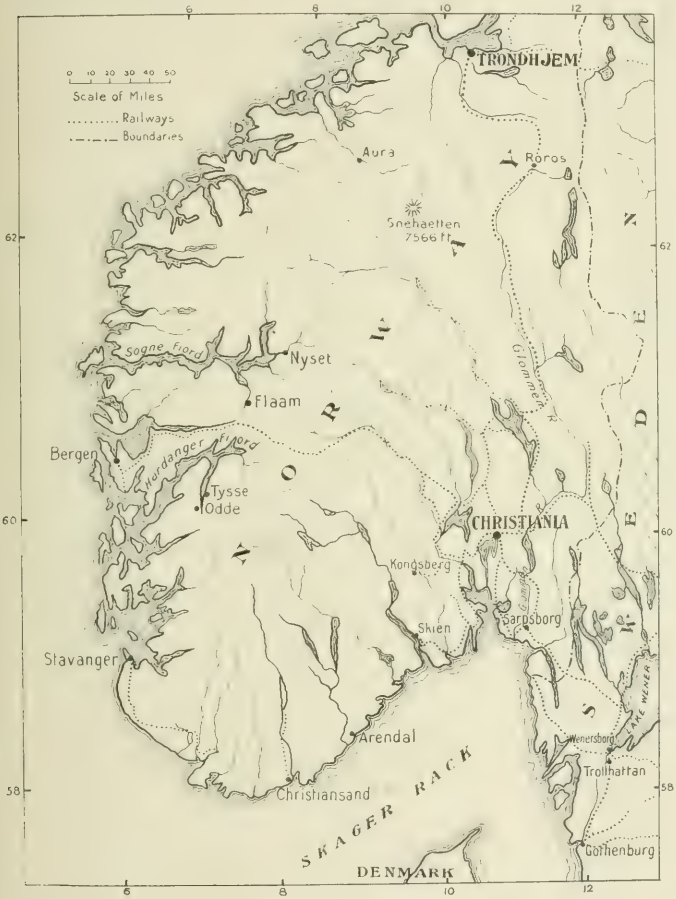


Johnson's Electric Zinc Furnace.

of the charge, and the current is so regulated that the temperature of the slag shall be 1250° to 1300° C, and that the escaping gases on arriving at the condenser shall be about 850° C. Between the furnace and the condenser is interposed a column of coke that is kept incandescent by means of an electric current. The function of this is to reduce the carbonic acid in the gases to carbonic oxide, and in this way to prevent the formation of fume as much as possible. The zinc vapour and carbonic oxide are then made to impinge on liquid zinc in the condenser. When treating an ore containing lead, the latter is reduced and collects as bullion that can be tapped, while iron and copper with any sulphur will form a matte, just as in a lead-smelting furnace. The condition of the furnace is such that the reducing action is strong enough to distil the zinc, but not to reduce any appreciable amount of iron in the slag. Mr. Richards states that, in this small furnace, when treating fairly clean zinc ores, and when recovering 75% of the zinc in liquid form, two tons of metal can be produced per horsepower-year. In this furnace the general physical conditions of the ore must be much the same as in the present retort practice; that is to say, there must be little gangue, and the sulphur must be roasted and the carbonates calcined.

Electric Smelting of Zinc-Lead Ores.—It has elsewhere been announced that an English company has been formed for the purpose of acquiring two electric smelting works, one at Sarpsborg, Norway, and one at Trollhattan, Sweden, and also the rights in connection with the construction of another at Tysse, near Odde, in Norway. The process and furnace used at these works are intended for the treatment of complex sulphide ores, and other material such as Broken Hill slime, and the intimately mixed sulphides of lead, zinc, copper, and iron that occur in large quantities in various parts of the world, at present of little or no commercial value. Reports have been made by J. C. Moulden for the Sulphide Corporation, and by F. W. Harbord, the latter of whom made thorough tests of the plants at Sarpsborg and Trollhattan. We cull the information here given from the reports of these experts. The electric furnace employed has carbon electrodes, and the heating and melting of the charge is effected by resistance with a current of low voltage. One electrode is in the bed, and the upper one is removable through the roof. The cross-section of the upper electrode measures approximately 2¼ sq ft. In the first furnaces the charge was introduced through the roof, but more recently the door is placed in the side and the operation is thus made more continuous. The capacity is 3 tons, and 2·8 tons of roasted ore can be treated per 24 hours. The horse-power per furnace is 350, and at Trollhattan the cost of power supplied by the hydro-electric company is 30s. 3d. per horsepower-year. At Mr. Harbord's tests on roasted Broken Hill slime, the energy used per ton of ore was 2078 kilowatt-hours. There are 11 furnaces at Trollhattan. The roasted ore, coke or anthracite dust, and flux are charged into the furnace, and most of the zinc and some of the lead is volatilized. The greater proportion of this is condensed as a crude spelter with high lead content, but much of it is precipitated as metallic fume and oxide, and has to be returned to the furnace in subsequent charges. The lead that is not volatilized is reduced as liquid metal, and it contains a considerable proportion of the silver. Matte is formed of the iron, copper, and sulphur, if present in the ore, and some of the lead, zinc, and silver passes into it. Some lead also escapes with the slag. The crude zinc is refined in other electric furnaces and the final zinc product is exceptionally pure, averaging 99·9%, and commanding a premium price in the market. At the time Mr. Harbord made his examination, the furnaces were built of porous material, apparently similar to that used in old-fashioned zinc-distilling retorts, and some of the lead and silver percolated through and had to be caught underneath; this he calls 'leakage' lead. He found also that the lead that exuded in this way during his experiments did not necessarily come from the charges under his observation, and was partly produced during the treatment of other ore at an earlier period. Thus the silver contents of the lead did not at all coincide with that of the ore treated by him. The general results of his trials were by no means ideal, and he makes many suggestions for improvements; but his conclusions are that the process may easily be developed into one of prime importance, especially at the new plant proposed at Tysse, where the estimated cost of a horse-power-year is only 14 shillings. During his experiments

at Trollhattan, seven furnaces treated, during 27½ days, 518 tons of roasted Broken Hill slime, 19 tons of calamine, 22½ tons of zinc-lead powder produced previously, and produced 160·8 tons of crude zinc which by refining yielded 112·4 tons of pure zinc and 24·7 tons of lead, together with 36 tons of powder; in addition to which 41 tons of lead was tapped containing 141 oz. silver per ton, and 'leak' lead amounting to 17 tons was recovered assaying 27 oz. silver per ton, also 9 tons of skimmings containing zinc, lead, and silver. The recovery from these various sources was 64% of the zinc, 74% of the lead, and 46% of the silver, not reckoning the metals recovered in the powder form. Mr. Harbord goes into details as to many points where increased extraction and lower costs may be obtained. Mr. Moulden is of opinion that, by means of improvements already indicated, the extraction should eventually be 75% of the zinc, 80% of the lead, and 80% of the silver, and on this basis he figures the profit obtainable on slime bought from the Sulphide Corporation and shipped to Sweden. This slime is taken to average 32% zinc, 23% lead, and 25 oz. silver, and on the current basis of payment would cost £2. 16s. 8d. per ton at Broken Hill. The freight to Trollhattan would be £2. 5s. 3d., making the total cost per ton at the smelter £5. 8s. 5d. The value of the recovered metals on the percentage figured by Mr. Moulden would be £9. 9s. 11d. The cost of treatment he estimates at £3. 0s. 7d., so that the margin of profit would be £1. 9s. per ton of slime. It is unnecessary to say that the process is in its infancy, and that many improvements are already obvious; also that everything depends on the cost of electric heat. Enough is shown, however, in these reports to make it clear that the process and method of metallurgy deserve close attention.



Southern Norway, showing Position of Hydro-Electric Zinc-Smelting Plants.

Ore-Shoots at Pachuca.—In *Economic Geology* for August, Fred J. Pope contributes a paper on the ore-shoots in the Pachuca district, Mexico. He shows that their occurrence is associated with certain characteristics of the country rock, characteristics which are the result of magmatic differentiation. Owing to the terms of professional engagements, he is not at liberty to describe the ore-shoots in detail, nor to specify the names of the particular mines where he studied the question; but we know that the Santa Gertrudis is one of them, and that his deductions had important influence in the calculations of reserves. The sedimentary rocks in the district are Tertiary, and the silver-bearing veins are found in dome-shaped intrusions of andesite-porphyry. A study of the rocks shows that, after these intrusions, there were others of andesite and of rhyolite with intermediate erosions, and, later, intrusions of quartz-porphyry dikes that cut through all the andesites. Then followed a period of faulting, and the silicification of the fissures. Up to this time no mineral of economic value had made its appearance, but subsequently there was a second period of faulting, generally along the same fissures, during which the argentite was deposited in the fracture-fissures of the andesite-porphyry domes. This andesite-porphyry exhibits variations in its constitution. Most of it is of light grey-green colour and averages 65% silica, but other parts are dark reddish-brown and dark green, with not more than 60% silica, and also much tougher. There is no sharp dividing line between the two varieties. The basic rock occurs irregularly throughout the lighter rock, and is usually in the form of lenticular masses. By experience the basic rock has been found unfavourable to the presence of ore.

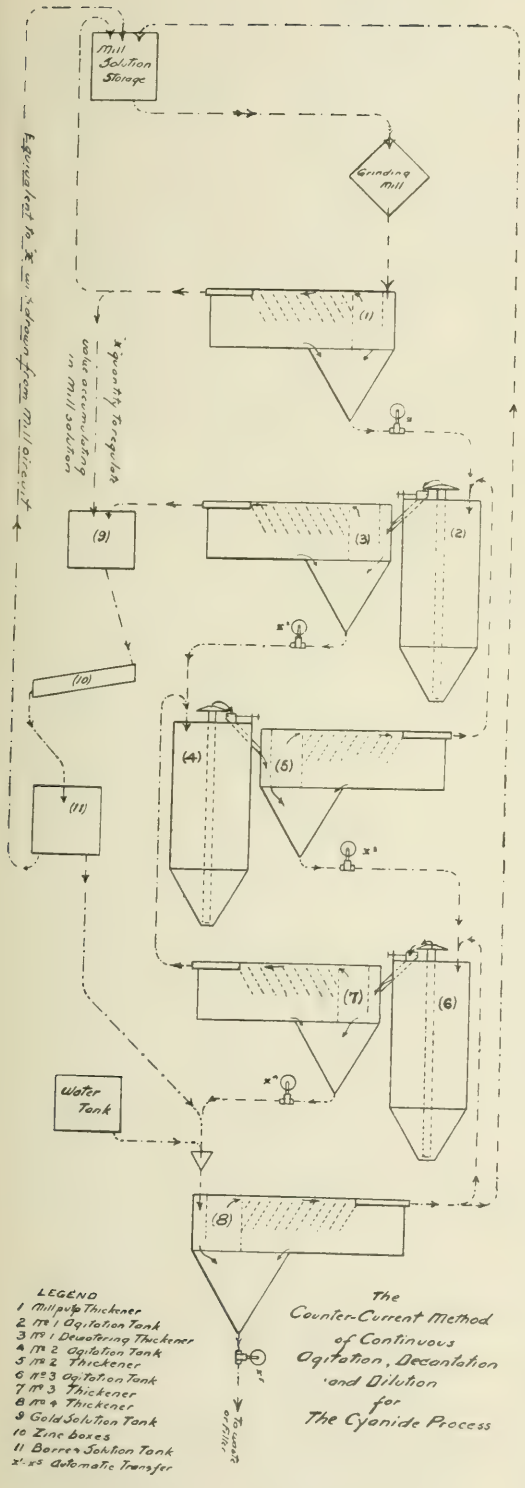
The veins are not simple fissures, but rather crushed zones varying from a few feet to 40 or 50 ft. in width. In some places the hanging wall and foot-wall are clearly defined; more often there is no dividing line, and the limits of economic ore can only be determined by sampling. After the first faulting, the solutions filled the interstices with silica and also attacked some of the brecciated rock metasomatically. In this faulting, the crushing of the softer and more acid rock would be more extensive and complete than that of the tougher and more basic, and larger cavities would be formed. The silica deposited would be more friable and more replacement would take place. With the tougher rock the silica deposited by replacement would be horny and harder even than much of the country rock. Considering all these circumstances, when the second faulting took place, the shattering would be greatest in the softer veins contained in the acid por-

tions of the rock, and the mineralizing solutions that afterwards flowed upward would pass along these opened channels. In this way the mineral veins would be formed in the acid portions of the andesite-porphyry rock. As regards the original formation of this rock, Mr. Pope shows that the basic portions could not have been formed separately at different times, but were undoubtedly due to magmatic differentiation during the cooling of one flow.

Removing Oil from Return Feed-Water.—In the *Monthly Journal* of the West Australian Chamber of Mines, C. E. Crocker gives an account of a plant used at the Kalgoorlie Electric Power & Lighting Co.'s works, for reducing the amount of oil in the water that comes from the condensers, before returning the water to the boiler-feed. Oil is destructive to boiler plates and tubes, and a thin film upon the inside will retard the transmission of heat as much as $\frac{1}{8}$ in. of scale. Most of the oil can be removed by skimming, and it is only that which has been made into an emulsion by the action of steam that causes difficulty. Many different methods were tried, and finally coagulation with alum and soda was adopted, as being cheapest and most effective. The author does not claim this method as new, but considers that his experience will be useful to mining engineers in out-of-the-way places. The water contains 3·5 grains of oil per gallon, and after treatment 0·85 grains. The cost of chemicals is 1·15d. per 1000 gallons; 0·35 lb. of alum and 0·3 lb. of soda are used per 1000 gal. In the Kalgoorlie plant, 50,000 gal. of water is treated per 24 hours. The two chemicals are dissolved in separate tanks and the solutions allowed to drop into a long, shallow, mixing tank through which the oily water runs. The mixture is then delivered to a second mixing tank of similar shape. Both tanks have baffle boards, over and under which the water flows, and the second tank, towards the discharge end, contains rough filtering material such as firewood. The water then runs to a series of filter drums of upright cylindrical shape. These contain horizontal perforated trays about half-way down, on which is placed filtering material such as coke, wood-wool, or shavings. Sand is not suitable as it clogs too soon. The precipitate is light and easily broken, so no eddies or agitation must be allowed. The capacity of the tanks and filters is such that five hours are occupied in the passage of the water. Mr. Crocker is of opinion that a longer time would be advantageous, as it would give a better extraction and a less consumption of chemicals.

Zinc Oxide.—The *Engineering and Mining Journal* for September 23 describes a process invented by Abraham Blum of Monterey, Mexico, for the production of zinc oxide from low grade ores, and slags and other residues. It is a modification of the Wetherill process, and consists of the use of a Huntington-Heberlein pot. The Wetherill process has been used for many years in New Jersey and Pennsylvania. The zinc-bearing material is calcined or roasted, mixed with powdered coal, spread on a reverberatory, and exposed to a low-pressure blast coming upward through perforations. The zinc is distilled and is immediately oxidized and collected as zinc white. In Mr. Blum's invention the reverberatory is displaced by a pot. By this means several layers of ore and coal can be placed on the hearth, and a much higher pressure can be used. Thus the rate of treatment can be greatly increased and the cost of labour lessened. The ore that he has been treating is the low grade fine from Minas Vejas. This contains, before roasting, 23% zinc and 23% iron, and is free from lead and arsenic. The oxide obtained assayed 76·5% zinc. With ores containing lead, the product would be a white zinc-lead pigment. The Wetherill process is restricted as to temperature by the formation of liquid slag which stops up the perforations in the grate; but in the pot used by Mr. Blum a fairly porous sinter is obtained which does not interfere with the blast and can be readily discharged. The blast can be so regulated that no iron goes over with the zinc, and thus the yellow or brown stain is obviated; also the heat is such that the zinc oxide is not crystallized, but passes over as impalpable powder. The conical pot used by Mr. Blum is 1·2 metres wide and 1 metre deep, and the charge consists of 120 Kg. 1 of coal and 120 Kg. 1 of ore. The bottom layer is of coal, then a layer of ore and coal, then a layer of coal, and so on. After ignition, the blast is introduced below the grate, first at a pressure of 2 in., and then gradually increasing to 12 in. In half an hour a good reaction commences, and it is completed in 6 hours. Mr. Blum considers it possible to use a larger pot, bowl-shaped, 2·10 metres in diameter at the top and $\frac{3}{4}$ metre deep. This would treat a charge of 3 tons, and 3 charges could be worked in a day.

Continuous Cyanidation.—In our August issue we quoted in our 'Current Literature' column an article by John E. Rothwell advocating the adoption of pulp-thickeners in the cyanidation of slime, and the treatment of the slime in stages, using the strongest solution last and working the solution from vat to vat in the opposite direction to the flow of the pulp. The article appeared in the July issue of *Chemical and Metallurgical Engineering*. Mr. Rothwell returns to the subject in the September issue of the same paper, and describes a proposed installation adapting his ideas. Though this article is not a record of results, it contains matter of interest. In the usual cyanide process, the strong barren solution is used at the beginning of operations, and the rate of solution of the gold and silver decreases as the metals are taken up; consequently anything like a complete extraction takes a prolonged period. In some cases it is necessary to introduce fresh solution, not necessarily barren, in order to continue the extraction. According to the author's method, the solvent lowest in metal content and highest in free cyanide is applied to the ore after the greater proportion of metal has been dissolved. After treatment, this solution is separated by means of a pulp-thickener and delivered to another agitator vat to treat richer ore, and so on to the vat where solution weakest in cyanide and richest in metal attacks the slime as it comes from the grinding machines. Thus the installation consists of alternate pulp-thickeners and agitator vats, the solution removed by each thickener going to the previous vat and the pulp passing to the next one. The accompanying flow-sheet explains the method at a glance. The pulp from the grinding-mill (where cyanide is used) is dewatered in (*1*) and sent to agitator (*2*) where it is treated with solution removed by the thickener (*5*). After treatment, the pulp is thickened in (*3*) and passes to agitator (*4*), where it is treated with solution from thickener (*7*). Subsequently it goes to thickener (*5*) and on to agitator (*6*), where it is treated with solution from thickener (*8*). The pulp is then dewatered in (*7*) and goes to thickener (*8*), along with barren solution from (*11*) and sufficient water to make up waste. The overflow from (*8*) goes to agitator (*6*) and the surplus to the grinding-mill. The pulp discharged from (*8*) may be filtered or sent to waste according to the amount of cyanide solution worth recovering. Our readers will see that Mr. Rothwell's scheme is an ingenious modification of the recent application of the Dorr thickener



CONTINUOUS CYANIDATION.

CURRENT LITERATURE.

Reversing Ventilation.—In the *Colliery Guardian* for July 28 and August 4, 18, and 25, T. A. Southern and H. W. Halbaum discuss the principles involved in reversing the ventilation in coal mines. This subject is now receiving much attention owing to the proposal of the Government to make reversible ventilation compulsory.

Electric Hoisting.—The *Engineering and Mining Journal* for August 26 contains a description of the electric winding engine at the Ray copper mine, Arizona. An alternating current is generated 19 miles away and transmitted at 40,000 volts. This is transformed at the mine, and the motor driving the winding engine is operated at 440 volts. The motor runs continuously and is connected by ropes to the hoisting drums, which are brought into operation as desired by means of friction clutches.

Coaldust in Mines.—At the Cardiff meeting of the Institution of Mining Engineers held last month, Sam Mavor read a paper reviewing the various sources of the dust that accumulates in coal mines, together with the methods proposed for preventing its settlement, for effecting its removal, or for making it less liable to explosion. He also described the Hawa collector.

Weighing Ore on Travelling Belts.—In the *Engineering and Mining Journal*, E. H. Messiter describes an electric apparatus for weighing ore during its transport on a travelling belt. The momentary variations in weight as the belt passes a certain point are made to affect the resistance of an electric circuit.

Caving at Scranton.—In the September *Bulletin* of the American Institute of Mining Engineers, Eli T. Conner describes the workings of the coal seams under the town of Scranton, Pennsylvania, and discusses methods of supporting the roofs by flushing sand or culm, so preventing a recurrence of the caving that has alarmed the community on more than one occasion.

Mining at Melones.—In the *Engineering and Mining Journal* for September 16, W. G. Devereux describes the method of mining adopted at the Melones mine, in the mother lode of California. This article will be read with interest in conjunction with one by F. Langford on the adaptation of this method at Braden, Chile, that will appear in our next issue.

Mining at Crystal Falls.—The *Mining and Scientific Press* for September 2 contains an article by F. C. Roberts, describing the method of block-caving and sub-stoping at the Tobin mine, Crystal Falls, Michigan.

Valuing Mines.—In the *Mining and Scientific Press* for September 16, Morton Webber writes on 'estimating and valuing the future of mines'; he discusses the chances of the prolongation of ore-shoots and the degree to which such a prolongation may be assumed when estimating the eventual life of a mine.

Brakpan.—The *South African Mining Journal* for August 12 contains a full description of the metallurgical plant now at work at the Brakpan mine in the far east Rand.

McKesson Sizer.—*Mining Science* for September 14 describes an apparatus, somewhat like a concentrating table, used for sizing ore without screen or water.

Cyaniding Concentrate.—At the July meeting of the Chemical, Metallurgical, and Mining Society of South Africa, R. Lindsay read a paper describing the method adopted at the Geldenhuis Deep for treating the pyritic material that accumulates on the amalgamation plates. The material is scraped off every day, ground in barrels, and cleaned by being passed over

other plates. It is then all-slimed in a tube-mill, and cyanided by the method devised by A. F. Crosse some years ago and already described.

Treatment of Accumulated Slime.—At the July meeting of the Chemical, Metallurgical, and Mining Society of South Africa, J. E. R. Adendorff read a paper describing experiments undertaken to ascertain the best method of treating accumulated slime containing acid by means of air-lift agitatiou.

Sizing for Amalgamation.—In the *Canadian Mining Journal* for September 15, P. N. Nissen advocates a plan for improving amalgamation by sizing the pulp and having plates specially adapted for each size.

Fine Gold in Placers. — F. H. Hazard, in the *Engineering and Mining Journal* of August 26, discusses the necessity for evolving apparatus for catching fine gold and 'black-sand' contained in gravel, and describes a plant used at the Old Channel placer mine, Oregon.

Electric Tin Smelting. — In *Metallurgical and Chemical Engineering* for September, John Harden, of the Grondal-Kjellin Co., describes experiments made at St. Ives last year on the smelting of tin ores in the electric furnace.

Colorado Zinc Ore.—In the *Engineering and Mining Journal* for August 26, George O. Argall describes the present mining operations at Leadville, undertaken for the purpose of winning the carbonate and silicate of zinc, left behind in the mines in earlier days, when only lead ores were considered.

Lead Assay.— In the *Engineering and Mining Journal* for August 26, R. T. Wilder describes a modification in Low's bichromate-iodide method of estimating lead in ores.

Tin Assay.—The Report of the Inspector of Alkali Works for 1910 contains an article on the estimation of total and volatile sulphur in tin ores by S. E. Linder.

Iron Ore in New Zealand.—In the *Mining and Engineering Review* for August, S. Irwin Crookes describes the iron ore deposits at Parapara at the northern end of the south island of New Zealand. These deposits have already formed the subject of papers prepared by the geological survey, and are considered to be the most important in New Zealand or Australia. Mr. Crookes gives a dissertation as to their present economic value.

Evans-Stansfield Electric Steel.—The *Canadian Mining Journal* for September 15 gives a short notice of an electric steel process whereby high-class titanium tool-steel can be obtained direct from titaniferous iron ores, invented by J. W. Evans and Alfred Stansfield, and recently shown at the Canadian National Exhibition at Toronto.

Trollhattan Hydro-electric Power.— *Engineering* for September 22 contains an article giving full particulars of the hydro-electric power station at Trollhattan, Sweden. This is of particular interest at the present time, as will be seen by reference to an article in our Précis, on the application of this electric current to the smelting of complex sulphides.

Conversion Factors for Cost of Power.—*Metallurgical and Chemical Engineering* for September publishes tables calculated by Carl Hering giving conversion factors useful in connection with costs of electric power, such as £ per horse-power-year and cents per kilowatt-hour.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be supplied on application to The Mining Magazine.

BOOKS REVIEWED

THE MINERAL INDUSTRY: ITS STATISTICS, TECHNOLOGY, AND TRADE, DURING 1910. Edited by Albert Hill Fay. New York: The McGraw-Hill Book Co. For sale by *The Mining Magazine*. Price 42s.

Last year in reviewing the eighteenth yearly issue of this great reference book, founded by the late Richard P. Rothwell, we expressed regret that the owners of the *Engineering and Mining Journal* had disposed of the book to another firm of publishers and that W. R. Ingalls was no longer to be editor. We indeed feared that the publication would lose most of its glory, so we are all the more gratified to find that Volume 19 now issued well maintains the previous standard of excellence. Albert Hill Fay, the editor, has had the full advantage of Mr. Ingalls' highly developed organization for the collecting and recording of facts and figures, and many of the regular contributors of special reviews have remained faithful. For instance, L. S. Austin continues his record of progress in the metallurgy of copper, and C. H. Fulton still writes on progress in cyanidation. H. O. Hofman again reviews the metallurgy of lead, W R. Ingalls the metallurgy of zinc, and R. H. Richards ore-dressing and gold milling. The general scope of the volume is much more confined to North America than formerly. Mr. Fay has only had one year's editorship; he has now left to join the American Mining Bureau.

THE DIAMOND. By W. R. Cattelle. Cloth octavo, 440 pages, illustrated. London: John Lane. Price 7s. 6d. For sale by *The Mining Magazine*.

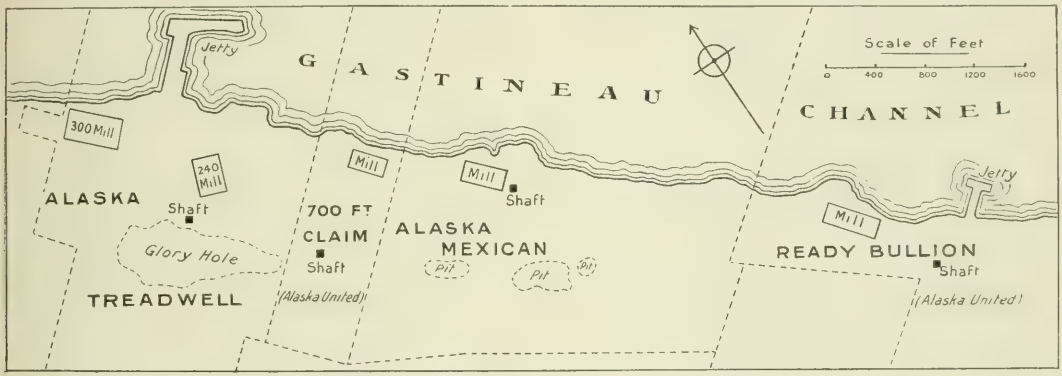
This is an American book written from the point of view of a commercial dealer having an inquiring mind and aptitude for intelligent study. The information given relating to the marketing of diamonds is first-hand, and is therefore of interest to those who want to know how it is possible for so many million pounds' worth of diamonds to be sold every year and the price still maintained. But it does not help the buyer or the dillettante to judge diamonds for himself; rather is he advised to find a dealer of repute and trust him. The rest of the book consists of a collection of facts and fancies connected with the stone. There is a chapter on celebrated diamonds and their history, which includes rumour and fable as well as fact, but without much attempt to analytically differentiate. The mines of India, Brazil, South Africa, and elsewhere are described in great detail. A chapter is devoted to the geology and the theories of origin. 'Diamonds in Literature' gives the more poetic side of the subject, but seems out of place in a book breathing dollars on every page. The author is more at home in describing the sorting and judging of stones, the varying colouring and flaws, and the methods of cutting and polishing. His lack of first-hand knowledge on other subjects is shown by errors in names, such as "Philipson Snow" instead of 'Stow,' and Barnett "J." Barnato, the latter mistake obscuring the old family name.

COPPER DEPOSITS OF THE APPALACHIAN STATES. By Walter Harvey Weed Paper covers, 166 pages, with many illustrations and maps. Washington: The United States Geological Survey.

This is Bulletin No. 455 of the United States Geological Survey, and it describes the copper mines of Vermont, New Jersey, Massachusetts, Virginia, and North Carolina, that in earlier days were important producers, and the Ducktown mines of Tennessee and Kentucky that still contribute their share of copper.

COMPANY REPORTS

Alaska Treadwell.—This company was formed in San Francisco in 1890 to acquire the Paris mine on Douglas Island, Alaska, on the opposite side of the Gastineau channel to Juneau. Adjoining properties on the same lode have been developed and worked by the same people. Of these the 700 ft. Claim mine of the Alaska United Co. is next to the Treadwell; and then comes the Mexican mine. The workings of these three are connected on several levels. Further to the east, and not connected with the Mexican, is the Ready Bullion mine belonging to the Alaska United. This statement makes clear the reason for the new policy to be adopted of hoisting the ore from the deep levels of the Treadwell, 700 ft. Claim, and the Mexican from one central shaft. For this purpose the main shaft of the 700 ft. Claim mine is to be enlarged and deepened. The ore so raised will be crushed at the surface, and then distributed by electric cars to the various stamp-mills. The winding engine will be capable of raising 5000 tons of ore from a depth of 3500 ft. in 20 hours,



THE ALASKA TREADWELL GROUP OF MINES.

and it will be driven by steam. The plan given herewith shows the position of the various properties, and we would mention here that the deeper workings are vertically below the Gastineau channel, particularly in the case of the Ready Bullion mine. The annual report now issued by the Alaska Treadwell covers the year ended May 31. It is announced that in future, in order to conform with Californian laws, the fiscal year will be made to coincide with the calendar year, so early in 1912 a report will be issued covering the 19 months from June 1, 1910 to December 31, 1911. The present report shows that the 240-stamp mill ran 181 days under steam and 168 days under water-power, while the 300-stamp mill used electric current for 17 days and water-power for 209 days. The total amount of ore milled was 770,084 tons, an increase of 25,858 tons over the previous year. The yield was $1,081,858 by amalgamation, or $1·40 per ton, and $730,441 from 14,221 tons of pyritic concentrate sent for treatment at the Tacoma smelter, or 95 cents per ton. The total yield was $1,812,299, or $2·35 per ton milled. A year ago the yield was $2,079,318, or $2·79 per ton milled. The year before that the yield was $2·21 per ton. The cost was $1,195,949, and other income besides the sale of gold was $93,962, so that the profit was $710,311, or 92 cents per ton. Out of this $600,000 was distributed as dividend and $100,000 written off for depreciation of plant. The ore reserve on May 15 was estimated at 6,637,370 tons, averaging $3·14 per ton, an increase of over 700,000 tons during the year. The report refers to the 100-ton cyanide plant erected for the purpose of treating the sulphide concentrate on the spot instead of shipping it to Tacoma. Though the process evolved was proved to be highly advantageous, the plant is not in operation, as the contract with the Tacoma smelter has not expired. The electric power-station at Sheep creek has been completed and is in use. The water used for generating the current is diverted from the channel of the creek a mile from the power house on Gastineau channel and 612 ft. above it. There are two 1000 kilowatt generators each driven by a Pelton wheel. The current is stepped up to 22,000 volts and transmitted 9 miles to Treadwell, where it is transformed to 2300 volts, at which pressure it is distributed.

Pena Copper.—This copper and sulphur mine in the South of Spain has been worked by an English company since 1900, having been previously managed from Belgium. The Siemens group own large interests in the company. Nicol Brown is chairman, Harvey & Wilbraham are the consulting engineers, and H. Schreck is general manager. When the mine was acquired by the English company, the finances and methods of management had to be extensively reorganized. The issued capital is £537,600 and there are £32,300 debentures outstanding, £67,700 having been redeemed from profits. Dividends of 5, 5, 4, and 7½% were paid from 1903 to 1906, but none since. During 1909 special expenditure was incurred in connection with the removal of overburden, so that it was impossible to distribute any dividend, and the profits for 1910 have been conserved, partly because of the long continued dispute originated by the Rio Tinto Co. The report for 1910 now published shows that during the year 132,559 tons of ore was raised; of this, 64,879 tons was sent to the leaching floors, and 67,680 tons delivered for export. A year ago it was decided to sell proportionately more ore for export and to treat less on the spot for copper content, so the figures for 1910 differ materially from those of 1909, when of the 130,784 tons raised 81,116 tons was sent to the heaps and 49,668 tons exported. The production during 1910 of fine copper by precipitation was 1017 tons. The shipments were: cupreous ore 19,260 tons, sulphur ore 47,498 tons, leached ore 78,052 tons, total 144,810 tons. The net profit, after payment of debenture interest and taxes was £32,844. Out of this, £10,900 was devoted to the redemption of debentures, and the balance carried forward. The position as regards water supply is excellent, as rain has been plentiful. The difficulties in connection with transport by the Rio Tinto railway will

within a short time be obviated, as the concession for the new railway has been granted, and construction is to be commenced forthwith. The company has been much worried lately by lawsuits brought by the Rio Tinto company in connection with the agreement relating to transport of ore, etc., over the latter company's railway to the port of Huelva. According to this agreement the Pena company, in return for transport facilities, undertook not to cut the prices of their produce in competition with the Rio Tinto company. In the lawsuits it was alleged that this had been done by the Pena company, but the first Court and the Court of Appeal held that the allegation was unsubstantiated. More recently, a similar action has been brought in Spain, a proceeding contrary to the agreement, which provided that all disputes should be settled in the English courts Under these circumstances, it is not surprising that the directors of the Pena company express their gratification at the fact that, when the new railway is completed, they will be independent of the Rio Tinto company.

San Miguel Copper.—This company was formed in 1904 to acquire from Spanish proprietors the San Miguel copper and sulphur mine in the south of Spain. Owing to mismanagement, the directors had to resign four years ago, and the control passed into the same hands of the Pena above-mentioned. The finances were drastically reorganized and a better system of mining devised. The report now issued covers the year 1910. It shows that the mining of ore by opencut has been restricted owing to the necessity for removing more overburden, and that not until 1912 will the output be restored to its normal level. The amount mined was 71,791 tons, as compared with 78,849 tons in 1909. Of this output, 62,276 tons was sent to the leaching floors and 9515 tons entered for export. The production of copper by the precipitation process was 730 tons, an increase of 88 tons over 1909. The deliveries of leached ore were 45,309 tons. After allowing £4354 for depreciation, the net profit was £5656, out of which the balance of mine development amount, £1865, was written off, and the remainder carried forward. The development work done during the year gave good results, and the ore reserve was increased by 38,000 tons, to 620,000 tons. Several promising indications have made it possible to increase the amount of development work. During the current year the shipments of cupreous ore and leached ore have been gradually increasing.

Globe & Phœnix.—The interim report, covering the six months ended June 30, of the leading Rhodesian gold mine shows that the amount and value of the reserve ore are well maintained. The figures at June 30 were 179,040 tons, averaging 36 dwt., as compared with 181,137 tons, averaging 35·2 dwt. on December 31 last, in the meantime 36,619 tons being extracted. Of this ore, 28,184 tons was high-grade, assaying 116 dwt. per ton over 51 inches, figures much the same as on December 31. The most recent developments on the 17th and 18th levels continue to disclose rich ore. One of the drifts 30 ft. long assays 12 oz. over 32 inches, and at one point the average of the face was 35 oz. The ore raised during the half-year, 36,619 tons, gave 49,611 oz. by amalgamation; the feed averaged 37 dwt. and the tailing 6·39 dwt. In the sand-plant, 13,083 tons yielded 609 oz., the feed containing 4·85 dwt. and the tailing 3·77 dwt., and in the slime-plant 15,196 tons of current and accumulated slime yielded 1746 oz. In addition, 1718 tons of concentrate was roasted and cyanided yielding 5444 oz. The total production was 57,411 oz. It will be seen that the sand-plant is giving poor results, and H. T. Brett, the consulting metallurgist, has decided, as foreshadowed in his article in this magazine for July, to erect roasting furnaces with sufficient capacity to treat 200 tons of accumulated and 100 tons of current sand per day. The cost of the new installation is estimated at £34,500. The revenue from the sale of gold during the half-year was £242,259, and the profit at the mine £181,868. The working cost, including development redemption, was 33s. 3d. per ton. The consulting engineer, H. A. Piper, and the manager, Theodore Haddon, give details of the progress of development and of various improvements made in the hoisting and pumping plant. They report that before long it will be necessary to inaugurate a system of ventilating.

Mount Bischoff Tin.—The half-yearly report of the premier tin mine of Tasmania, covering the year ended June 30, shows that owing to scarcity of labour it has not been possible to do any prospecting or to complete the erection of the new plant to which we referred in our issue of April last. The output of ore and concentrate therefore did not show the increase that was expected. The amount of ore mined was 113,441 tons and, after sorting, 101,310 tons was sent to the mill. During the previous six months the figures were 123,508 tons and 110,664 tons. Though the amount of ore treated was rather less, the grade was higher, so that the yield was 550 tons of concentrate, exactly the same as before. The smelting works at Launceston treated this amount and also 1240 tons of custom ore. The company's profit during the half-year was £43,377, of which £22,500 was distributed as dividend, £10,341 written off for depreciation, £8528 paid for new plant, £1932 spent on a new dam, and £1397 on development work, besides providing for taxes, etc. For the previous half-year the profit was £35,311, and the dividend £21,000. The directors report that the new reservoir on the Waratah river has been completed, and it is expected that in future the mine will never be short of water even in the driest season.

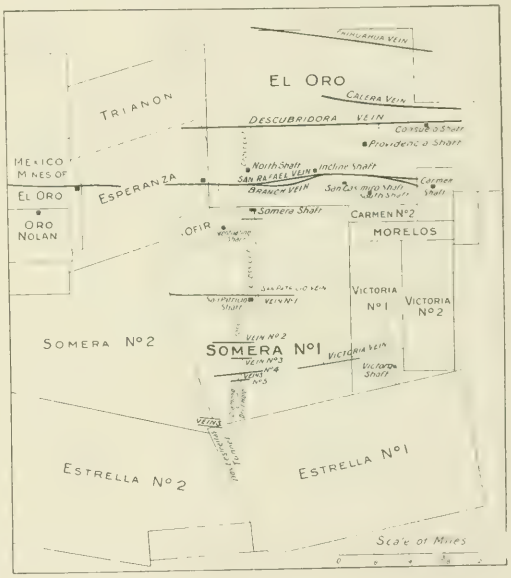
Anchor Tin.—This English company works an unusually low grade tin mine, or rather open stockwork, at Lottah, in the northeast of Tasmania, and since its formation in 1895 has never made any divisible profit. On two occasions, in 1902 and 1909, it has been necessary to reconstruct and provide further funds. The capital now consists of £25,159 in ordinary shares and £6540 in preference shares; there are also £25,000 of 4% debentures, and a loan of £5000 obtained from the Government for the specific purpose of building an aerial ropeway to a new property, the Australian mine. Bedford McNeill is consulting engineer and James B. Lewis is manager. The report now issued covers the year ended March 31, and shows that the drought which so much interfered with the operations during the previous year continued for some time into the year now under review, and it was not possible to resume crushing until May 1910. A stoppage of half the battery from the same cause occurred about Christmas. Then in March this year unusually heavy rains commenced and did much damage by flooding. During the time the water supply was ample, the labour was insufficient, and the battery could not be kept fully employed. The protracted drought had naturally caused the men to drift away, and owing to the general scarcity of labour throughout Australia, it was impossible to attract them back again when the mill resumed. During the twelve months, the average number of stamps at work was 68 out of 100, and the quantity of ore treated was 102,944 tons. The recovery was 155¾ tons of concentrate or 3·38 lb. per ton, equivalent to 2·38 lb. metallic tin per ton. These figures were much

the same as during the previous period ended March 31, 1910. The cost of mining, milling, and smelting was £18,054, or 3s. 5d. per ton, and the London and other expenses brought the total cost to £19,644. The concentrate is treated by the Mount Bischoff company at the Launceston smelting works. The new property, the Australian mine, was early this year brought into communication with the Anchor by the completion of the aerial ropeway, and during the short time it was worked before the close of the year, March 31, 4½ tons of concentrate was produced from this source. This property has not been purchased outright, but is being worked on the agreement that 75% of the profits shall go to the Anchor company. Mr. Lewis reports hopefully of it, but enough work has not yet been done to make it possible to give an exact estimate of the future.

Kinta Tin.—This company was formed in London in 1900 to acquire tin-gravel properties in Perak, Malay Peninsula. Osborne & Chappel are the managers. The dividends have been steady, and have increased from 10% in 1902–3 to 30% for 1909–10. The report now issued covers the year ended June 30, and shows a net profit of £23,101, out of which £15,000 has been distributed as dividend, being at the rate of 25%, and the remainder allocated to capital expenditure for a contemplated extension. During the year the output of tin concentrate was 322 tons, which sold for £33,774, or £104 per ton. The cost at the mine was £6305, and London expenses, taxes, payment to tributors, etc., £4348, leaving a profit as already mentioned of £23,101. The yield of concentrate was rather less than during the previous year, owing to the exceptional drought. As regards the contemplated extension of operations, the company has recently obtained a concession from the Government providing for a greatly increased water-supply, which will make it possible to develop additional properties. The necessary expenditure on such a scheme will be nearly £50,000, which means practically doubling the capital. The directors intend to go slowly in this matter and not to create new capital until the profitableness of the proposition is well proved.

Nigerian Tin Corporation.—We recorded the flotation of this company in December 1909, and mentioned that it was formed with no special property in view but for the purpose of taking up anything that offered. The directors have all had experience in tin mining in Cornwall or the Malay States, Oliver Wethered being chairman. The report now issued covers the period from the date of formation of the company to March 31 of this year. It states that H. O. Crighton, the manager, has acquired two sets of properties, near Bauchi and Ninkada respectively. Four properties in the former group have been worked primitively by means of calabash and have yielded sufficient tin to pay expenses. A sluicing plant is now on its way, and when in operation the output should be 30 tons per month. The Ninkada properties have not yet been systematically prospected, but tin is reported to be found in many streams and flats. The company has made a profit by the sale of shares in other companies, so in February £3978 was distributed as dividend, being at the rate of 10%. Since then, further capital has been expended, bringing the total issue so far to £45,782. At the meeting of shareholders, the chairman gave some further information about the cost of power. Up to the present time wood has been used as fuel, but the engineer has recommended the provision of power from a waterfall, not far from the property, from which 200 to 300 hp. can easily be obtained by pipe-line.

El Oro Mining & Railway.—The report of this company operating the gold mine 100 miles northwest of Mexico City for the year ended June 30 last shows that no material damage was done during the revolution, though operations were hindered by difficulties in connection with the transport of supplies, and by the unrest caused by the presence of armed bodies of men. As we gave a historical record of the company in our issue of October last year, we need not now recapitulate. The point of interest at present in connection with the mining and metallurgy is that increasing amounts of ore are being treated, of substantially less content, and at a much lower cost per ton, and that the divisible profit has been maintained. During the past year, 360,294 tons of ore yielded bullion worth $2,389,349, or $6·63 per ton; these figures compared with 316,138 tons, $2,562,705, and $8·10 for the previous twelve months. The recovery was 87% as compared with 91%. On the other hand the cost was



The El Oro District.

$1,405,016 or $3·90 per ton, as against $1,557,889 or $4·93 per ton. During the last three years or so the ore has been all-slimed and cyanided. The costs of mining and treatment are still being lowered, and A. F. Main, the manager, has made further improvements recently. The reserve on June 30 was estimated at 484,139 tons, averaging $7·66 gold and 3 oz. silver per ton, a total of $9·10; this compares with 441,639 tons averaging $9·50 a year ago. This ore is in the San Rafael, San Patricio, and Descubridora veins. In addition to these, work is being done on the No. 4 or Victoria vein in the Somera property, and the indications point to the vein becoming an important producer. As regards the railway, the profits have been lower, the figure being $103,120 as compared with $124,254. This fall is however unimportant and speaks well for the ability of the management in tiding over troublous times. In the company's profit and loss account £25,000 is allowed for depreciation; the dividend absorbed £172,125, being at the rate of 15%, and bringing the total distribution since the formation of the company to £1,525,437.

Salisbury Gold.—This company was formed under Natal laws in 1886 to acquire a small property on the outcrop in the central part of the Rand, and is under the same control and management as its neighbour the Jubilee, which has recently suspended operations. The two mines are surrounded by the Ferreira, City & Suburban, and Village Main Reef. Milling commenced in 1887, and the joint mill contains 100 stamps, of which 60 belong to the Salisbury. During the year ended June 30, 109,143 tons was mined and, after sorting, 93,396 tons was sent to the mill, where 12,519 oz. was extracted by amalgamation; 59,775 tons of sand yielded 6125 oz., and 27,632 tons of slime yielded 1107 oz., a total production of 19,990 oz. or 4·28 dwt. per ton milled, as compared with 4·77 dwt. a year ago. The revenue was £84,817 and the cost £69,511, leaving a profit of £15,306, out of which £13,500 has been distributed as dividend. The manager, W. T. Carr, estimates the ore reserve at 82,896 tons. Most of the work now being done consists of cleaning stopes, and removing as many pillars as possible. As already mentioned, the Jubilee has been abandoned, as the workings were nearly exhausted and had become unsafe; no doubt the cost of working at the Salisbury will advance in consequence. Two years ago the company, conjointly with the Jubilee, acquired a three-eighths interest in the Claremont and Nelly Extra mines, between Bulawayo and Selukwe. These properties were floated as a separate company, and 35,000 new shares were issued by the Salisbury company for the purpose of taking up their quota. Five stamps are at work, and Nissen stamps are being erected.

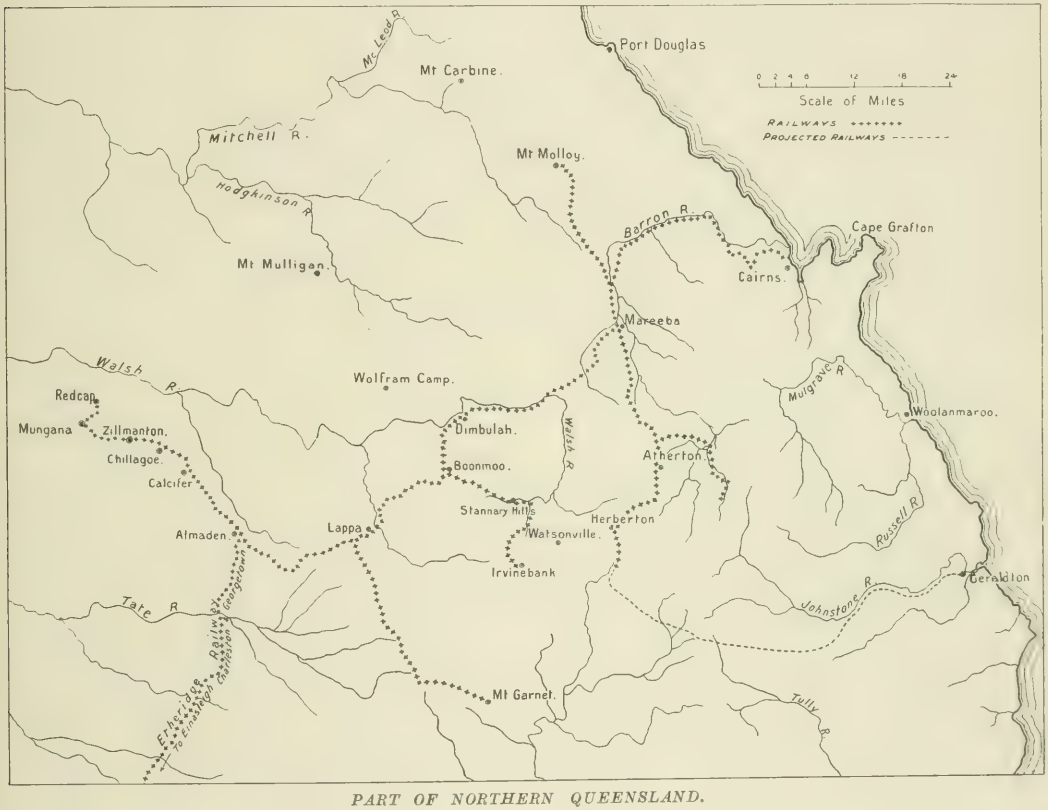
North Anantapur.—This company was formed in June 1908 by John Taylor & Sons, to acquire part of the property in Madras Presidency, India, that had been developed by the Anantapur Gold Field Co. The report now issued covers the year ended June 30. During this period the monthly output has been gradually raised from 700 tons to 1400 tons, and the number of stamps running has increased from 10 to 15. The total tonnage treated was 11,382, and the gold extracted by amalgamation was worth £18,629, or 32s. 8d. per ton. The expenditure was £20,545. The directors are proposing to issue 25,000 new shares, entitling holders to a 20% non-cumulative dividend, in order to provide funds for prosecuting the development work on a larger scale. W. Stonor, the superintendent, reports that at the northern end the recent exploratory work has revealed several profitable shoots; at one place, a cross-cut on the 200 ft. level passed through 5 ft. of ore averaging 1 oz. per ton. During the year, the ore reserve has increased from 8500 tons to 14,000 tons. Before deciding on an increase of capital, the directors sought the opinion of C. H. Richards, superintendent of the Nundydroog Co., and he fully confirmed Mr. Stonor's views. The mine is fully equipped with winding and pumping engines, and has a 14-drill compressor and 20 stamps, so that no further expenditure is required in this direction. The recovery by amalgamation is 82%, and the amount of gold left in the tailing is just under 2 dwt. At some future time a cyanide plant is to be provided.

Barramia Mining & Exploration.—This company operates a gold mine in Upper Egypt, situated 63 miles eastward from Edfu on the Nile. It was formed by John Taylor & Sons in July 1909, as a subsidiary of the Egypt & Sudan Mining Syndicate. The capital is £55,000, divided into 216,000 preference shares of 2s. 6d. each entitled to a 10% non-cumulative dividend, and 112,000 ordinary shares of 5s. each. The purchase consideration paid to the syndicate was the whole of the ordinary shares, £1350 in preference shares, and £5000 in cash. The remaining 205,200 preference shares were subscribed in cash by shareholders in the vendor and allied syndicates. The preference shares are entitled, in addition to the 10% dividend, to $\frac{77}{55}$ths of the subsequent profits in any one year. The mine was worked by the ancients, and is characterized by veins that are narrow and occasionally of high value. The present report covers the year ended June 30. During that period, 1861 tons of ore was mined and milled, and gold worth £18,689 was extracted. The net profit, after allowing for taxes, London expenses, and depreciation, was £3360, out of which £2700 has been paid as the 10% preference dividend. In addition £3857 has been spent out of capital on buildings, plant, and shaft-sinking. Transport over the desert to Edfu is one of the troublesome problems During the year a motor wagon of 2-ton capacity was bought; unfortunately it proved to be far too heavy for ploughing through the sands of the desert, so it has been discarded. In January last, the mill was doubled by the addition of 5 stamps. The mill now contains 10 stamps, weighing 500 lb. each, and can crush 12·8 tons per day of 16 hours through 30 mesh. The superintendent, Arthur J. Rickard, gives full details of development work. The pockety nature of the ground is evidenced by the fact that in a winze below the 130 ft. level, 1 cwt. of ore contained 230 oz. of gold. The most promising part of the mine is Taylor's reef, which has recently been proved on the 250 ft. level.

Chillagoe.—This company was formed in Melbourne in 1898 for the purpose of working copper and lead deposits in North Queensland and to construct railways, and it has now a great ramification of interests, including a smelting works, mines, railways, holdings in subsidiary mining companies, and contracts for the supply of custom ore. The company's own mines, the Zillmanton, Boomerang, and Redcap, are not as productive as formerly, nor are the ores from the Mungana, a subsidiary, so profitable nowadays. During the last year or two, supplies of copper ore have come from the Einasleigh mine, particulars of which were given in our issue of April last. Mines have also been acquired at Forsayth, in the Etheridge district, and floated as a separate company. The company built and owns the Chillagoe railway, that starts at Mareeba, and is now nearly completing the Etheridge railway to connect Almaden on the Chillagoe railway with Einasleigh, Charleston, and Georgetown. The capital of the company is £452,856 in shares, and there are £800,000 debentures. The report now issued covers the year ended March 31 last. The Zillmanton, Boomerang, and Redcap mines produced only 4670 tons between them. The first named yielded 2253 tons of 4½% copper ore, and from the others the production was chiefly fluxing ore. Development work was confined to the Zillmanton, and the prospects are only moderate. The mines at Forsayth are promising; they contain copper and lead ores with high gold contents. At the smelting works a copper furnace, a lead furnace, and a smaller one for copper-lead ores have been in commission during the year, the copper furnace continuously, and the lead furnace for six months. The total ore treated was 60,943 tons, and the shipments were 2441 tons of lead bullion containing 1053 oz. gold and 197,371 oz. silver, and 3321 tons of blister copper containing 10,592 oz. gold and 315,254 oz. silver. The working account shows a profit on the mine and smelter of £21,000, and in addition there was a profit on the railway of £78,800, so that the working profit was £99,800. Out of this £28,665 went as debenture interest, £10,400 as general expenses, and £55,373 was written off for mine development and

for depreciation. The shareholders have never received any dividend, and the company has been reconstructed twice, in 1902 and 1905. E. A. Weinberg is consulting engineer, E. J. J. Rodda is mine manager, and J. Horsburgh is metallurgist.

Mungana Chillagoe.—This company was formed in Melbourne in 1901 to acquire the Girofla and Lady Jane mines from the Chillagoe company, which still owns a preponderating interest in the share capital. The ore is complex and of varying grade and constitution. It occurs in bunches in limestone. Most of it consists of mixed argentiferous lead-copper sulphides, but there are oxides and carbonates present as well. Separation



PART OF NORTHERN QUEENSLAND.

by water concentration is impossible. Originally the whole of the ore, which is smelted by the Chillagoe company, was first treated for lead, and the copper-lead matte then sent to the copper furnaces. During the last two years, however, the low price of lead has made the first treatment unprofitable, so the ore is now sent direct to the copper furnaces. Much of the lead content is therefore sacrificed. The report for the year ended March 31 just issued shows that 22,489 tons was delivered to the smelter, averaging by assay 17·36% lead, 7·44% copper, and 15·43 oz. silver. The metal paid for was 1873 tons lead, 1529 tons copper, and 350,073 oz. silver. It will be seen that the returns on the copper and silver were about the normal results of smelting, but that over half the lead was lost. The receipts were £61,051 and the net profit £14,711, which was carried forward. Owing to the fire and creep at the Lady Jane two years ago, it was not possible to raise more than 8000 tons during the year, and the remainder of the year's output came from the Girofla. The Lady Jane is still burning, or at least is still hot, and great difficulty is experienced in reclaiming the lower levels. As regards the ore reserves, S. N. Rodda, the general manager, estimates them at 55,000 tons in the Lady Jane, and 101,000 tons in the Girofla.

North Broken Hill.—We recorded in our May issue that this company, which is one of the two most prosperous silver-lead-zinc mines on the Barrier range, New South Wales, had not been able to work the new lead-concentration plant to full capacity owing to shortage of labour. The half-yearly report now issued, covering the period ended June 30, shows that this difficulty is still present, and indeed has caused the output of the mine to decrease by 5000 tons and the profit by £8500. The ore raised was 127,407 tons, and the concentrator treated 128,272 tons averaging 15·9% lead, 13% zinc, and 6·4 oz. silver. The production of lead concentrate was 21,895 tons assaying 71·4% lead, 6·1% zinc, and 20·5 oz. silver, being a recovery of 76·8% of the lead and 54·8% of the silver. The zinc tailing produced was 67,413 tons, assaying 3·6% lead, 16·7% zinc, and 3·2 oz. silver. This was delivered to the Amalgamated Zinc (De Bavay's) for treatment. In addition, 12,226 tons of slime was produced, averaging 13·1% lead, 16·1% zinc, and 8·2 oz. silver. The slime-treatment plant is being extended, but is not in use yet. The old slime dump containing 90,000 tons has been sold for 7s. 6d. per ton to the Junction North company. Owing to the increase in wages in Australia, the cost of operation has advanced by 1s. 4d. per ton of ore, and now stands at 14s. 7d. per ton. The profit

for the half-year was £66,808 ; the allowance for depreciation was £12,661, and £52,500 was distributed as dividend, being at the rate of 30% for the half year. As regards developments, the reports are most favourable. The reserve above the 1100 ft. level remains at 1,500,000 tons, and the discoveries on the 1250 ft level are important, the cross-cut passing through 19 ft. of ore averaging 16½% lead, 15½% zinc, and 7½ oz. silver. Similarly the southern body on the 1100 ft. level is being proved to contain valuable additions to the ore reserve, four cross-cuts showing the width of the lode to be 50 to 70 ft. wide, and assaying as high as the average grade of the mine.

Broken Hill South Silver.—This and the North company, particulars of which are given in the preceding paragraph, are the two most prosperous on the Barrier Range at the present time. A new lead concentrator was completed at the beginning of 1909, but was not put in commission immediately, owing to delay in fixing a satisfactory contract for the sale of concentrate. Another period of inactivity occurred at the beginning of 1910 owing to the coal strike. Since then the operations have been practically continuous, except for a short time at the beginning of 1911 when the full complement of skilled labour could not be maintained. The report for the half-year ended June 30 shows that 175,044 tons was mined and concentrated, averaging 14·6% lead, 13·6% zinc, and 6·5 oz. silver. From this 26,617 tons of lead concentrate was produced, averaging 71·6% lead, 5·2% zinc, and 23·2 oz. silver. In addition, 95,990 tons of zinc tailing was produced averaging 3·7% lead, 17·6% zinc, and 3·8 oz. silver, together with quartz tailing and slime. The zinc tailing was delivered to the Amalgamated Zinc (De Bavay's) together with 16,721 tons of accumulated tailing, while 8991 tons of old mill tailing averaging 11% lead, 20% zinc, and 4 oz. silver was delivered to the Zinc Corporation. The untreated accumulations consist of over a million tons of zinc tailing belonging to the Zinc Corporation, and 115,000 tons due to the Amalgamated Zinc ; also 261,692 tons of slime. The income from the sale of lead concentrate was £209,113, and of zinc tailing £41,945, a total of £251,058. The profit was £72,578, out of which £60,000 has been distributed as dividend, being the same as during the previous half-year, and comparing with £20,000 this time last year. As regards developments, the work on the 1070 ft. and 1170 ft. levels has made substantial additions to the ore reserve. The increase in the rate of wages of 10% since January 1 has added 1s. 1d. to the cost per ton, but economies reduced the increase to 11d. The cost, including mining, filling stopes, development and concentrating was 17s. 1d. per ton

New Einasleigh. — This company was formed in London in 1907 to acquire a copper mine, situated at the junction of the Einasleigh and Copperfield rivers in North Queensland, and about 120 miles on the Etheridge railway south of Chillagoe. The control is with the same group as the British Broken Hill ; Alexander Stewart and W. H. Woodhead are on the board. In our issues of July last year and April of this year we gave particulars of the ore deposit. The report for the year ended January 31 has just been issued. It shows that 20,096 tons of ore, estimated to contain 1374 tons of copper, was shipped to the Chillagoe smelter, and realized £22,583. The costs at the mine were £15,233, and other expenses £2956 ; after paying £2876 as debenture interest, the balance of profit was £710. Owing to delays in the erection of the concentration plant, it has not been possible to treat the large amount of lower grade ore that has already been raised to surface. The plant is now on the spot, but as the company is short of funds, it has not yet been put into commission. Development work in the mine has given good results on the 3rd and 4th levels. On the 3rd level the rich shoot has been proved for 266 ft., and on the 4th level for 245 ft. The nature of the ore has altered with depth ; in the upper levels it was highly silicious, but more recently it has become basic. The directors are therefore considering the advisability of smelting on the spot. A scheme for raising further working capital for the purpose of continuing development, erecting the concentrator, and building a smelter, is to be placed before shareholders H. Adler has relinquished the management of the mine, and the position is held temporarily by H. P. Wallmann.

Ida H.—This gold mine is situated in the Mount Margaret district of West Australia, and was introduced in London in 1900 by the North-Waddington group. From 1902 to 1906 satisfactory dividends were paid on the small capital £54,000, amounting to 142½% in all. For the last four years no divisible profit has been made. The report now issued covers the 18 months ended June 30, and shows that 20,940 tons of ore was crushed yielding gold worth £55,341. The mining and administration expenses were £36,021, £1771 was allowed for depreciation, and £16,083 written off the development account. At the end of March this year, Campbell Shaw, the manager, resigned, and Hooper, Speak, & Feilding were appointed consulting engineers. At the recommendation of their local partner, R. A. Varden, the hoisting of ore was suspended in June, and several improvements effected above and below ground, the straightening, re-timbering, and re-equipment of the shaft being the most important. Milling commenced again in September.

TRADE NOTES

Most of the trade publications mentioned in this column are available for distribution and the manager of "The Mining Magazine" will be pleased to secure copies for persons interested.

Users of Hand Pumps will find useful information in the booklet issued by W. H. Wilcox & Co.

The British Humboldt Engineering Co. report the sale of a second Wetherill separator to Davis & Soper, for Tasmania.

Dorr Thickeners have been adopted at the new plant erected at the Globe & Phœnix mine, Rhodesia, for the cyanidation of roasted antimonial slime.

Robert Boby Ltd. make the 'Neckar' water softening and boiler-mud extracting apparatus and have just issued a 16-page booklet illustrating and describing its application and advantages.

The British Aluminium Co. have issued under date of September 1911, a 20-page bulletin describing the uses of aluminium in the electrical industry, giving particular attention to its value in the transmission of electric current.

Walker Brothers have issued a pamphlet devoted to Air Compressing Machinery. It deals in detail with the increased efficiency secured from higher piston speed made possible by the use of a new type of air valve. The latest compressors are also equipped with an improved unloading device.

The McKiernan-Terry Drill Co. have issued a new and comprehensive catalogue describing their core-drill. It contains information compiled from operations in the field, and is particularly interesting in describing successful bores made up to 30 in. diameter, and illustrates cores taken from these large holes.

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Scientia non habet inimicum nisi ignorantem.

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REVIEW OF MINING

INTRODUCTORY.—The mining market has exhibited a better tone since our last issue appeared. On November 4 the Moroccan treaty was signed by France and Germany, ratifying a peaceful settlement of that difficulty. The result had been discounted, but it was no less gratifying when it became a fact. The Chinese revolution, on the other hand, has not affected the European share markets as yet, owing to the aloofness of the Western world, but the monetary requirements of the combatants on the Yangtze Kiang have influenced the demand for silver, and are likely to do so increasingly. A recovery at New York has contributed to a more hopeful outlook. The Gold Fields report and the later speech of the chairman, Lord Harris, have had a cheering effect. The market at Johannesburg has broadened considerably. A large bear account has been disclosed in Tanganyikas, where matters appear to be coming to a head. The Rhodesian department is more lively and several new issues are imminent. The money market is favourable to new flotations, several large non-mining issues having been largely over-subscribed recently. If we are spared further untoward happenings on the Rand we may expect a steady recovery, for the supply of labour improves at this season in South Africa, and the beginning of winter brings financiers from the covert and the links to Throgmorton Street.

TRANSVAAL.—The statistics of gold output for September created a good impression, although they merely indicated a continuance of the rate of production recorded in the two preceding months. The yield was 700,625 ounces, worth £2,976,065, for the short month of 30 days, as compared with 713,407 ounces, worth £3,030,360, during the 31 days of August. If the present rate of output is maintained for the remaining three months the total for the year will be 8,200,000 ounces, or about £35,000,000, as against 7,532,322 oz. and £31,995,266 in 1910. On analysing the returns it is seen that the average yield was 8 pence per ton better in September than in August, which suffered from the East Rand collapse, and 2d. per ton better than in July. The average cost for the month was 4d. higher than in August, so that the resulting profit was 4d. per ton higher. The total profit was £952,665, which is the lowest since March. As regards labour, the decrease in the supply of natives was only 191, as against a preliminary estimated loss of 500; but last year in September there was a gain of 1369; therefore the figures are disappointing. In October the loss was 548.

Anxiety concerning the water-supply on the Rand was accentuated by the action taken by the local Water Board, which reduced the supply to the mines by 30%; but the breaking of the drought announced on October 25 had a reassuring effect. Most of the mining companies have reservoirs of their own and their use of the municipal supply is due to its relative cheapness and purity. No cause for alarm exists. Recent reference to excessive mortality among natives working underground in the mines of the Rand would suggest that silicosis was at its worst in the gold mines, but it appears that in 1910 the mortality in the diamond mines of South Africa was 44·9 per thousand, as compared with 32·6 in the deep-level gold mines and 24·7 in the outcrop mines. The exceptionally heavy rate of mortality at the Premier diamond mine is engaging the attention of the Health Department.

The New Modderfontein report is cheerful, showing increased gold output, larger profit, and bigger dividends; in other words, it is an

expanding enterprise. The reserve is now estimated at 3,342,000 tons at 7½ dwt. per ton, as against the average yield for the past year, namely, 29s. 5d. per ton. The working cost is 17s. 4d. per ton, but this relatively high figure is attributed to outlay in preparatory work.

The Benoni mill was started at the end of September and would have started earlier if a sufficient supply of native labour had been available. In this mill the Arbuckle dewatering cones have been adopted, followed by the Way-Arbuckle agitators. On September 29 the new mill at the Modderfontein B mine commenced crushing, and in the same week the Crown Reef mill of the Crown Mines was started. This makes three plants that entered the productive stage at about the same time; the haste to get under way being due to an Act passed by the Union Parliament whereby no mills that were started after September 30 are allowed to operate on Sundays. The law does not affect those already in operation at that date.

The October outputs and profits of the General Mining (or Albu) group are excellent, especially at the Meyer & Charlton, which gave a profit of £13,045, the highest recorded in the history of that mine. The average working cost for the group was 17s. 11d. per ton.

The Zaaiplaats, a tin mine, has been earning big profits, paying £110,000 or 185% in dividends, leaving a balance of £27,675, besides £12,192 spent in plant during the year ending July 31. Additional stamps are to be erected, increasing the mill to 35 stamps.

RHODESIA.—The September gold output was 53,615 ounces, worth £225,777, this being a decrease of 4275 oz. or £17,935 as against the month preceding. The number of productive mines decreased from 174 to 168. However, these figures were deemed satisfactory, having regard to the shortage of labour, which it was feared would cause a more serious diminution of the output. The premier mine, the Globe & Phœnix, is responsible for most of the loss, the individual decrease being 2811 oz., that is, from 11,017 to 8206 ounces.

Reports from the Shamva continue excellent, 310,000 tons having been added to the reserve, which is now 1,555,000 tons averaging 4·77 dwt. after allowing for accidentally rich samples. The work on the No. 2 level has contributed one-third of the tonnage and it is of higher grade than that exposed on the No. 1 level. Winzes below the second level make a good showing, so that on the whole the mine never looked better. With 500,000 shares quoted at £4 1 5/6, the market valuation stands at £2,468,500. The profit to be expected is about 7s. 6d. per ton, so that the ore now available represents a total profit of about £600,000. The Shamva is a tall gamble.

By making liberal use of the gold reserve the output of the Globe & Phœnix was modified to a degree possibly misleading. In September, with a reduced output and a profit of only £2700, an addition of 1152 oz. was made to the gold reserve; in August, with a larger yield, 1687 oz. was withdrawn from the reserve, swelling the nominal profit to £33,600. In this and in other cases it is obvious that the gold reserve tends to confuse the returns. Shortage of labour explains the diminished production during September, the mill being operated for 21½ days only.

Both the Sheba and Pigg's Peak are able to announce improved prospects in their annual reports. Two 5% dividends are to be paid by the famous old mine at Barberton. At the Pigg's Peak the problem of ore treatment appears to have been solved, the extraction having been raised from 50% two years ago to 92½% in August last.

Tanganyika Concessions has suffered by lack of information concerning the smelting operations, which have now been in progress for several months. The re-assertion of opti-

mistic forecasts is no longer convincing, and it is evident that even Mr. Robert Williams's most fervid followers have become timid. We do not care to harp on the subject, for our criticisms of this enterprise, published in January 1910, hold good.

A 2s. dividend from the Lonely Reef and good reports concerning the deepest development in that mine are pleasing items of Rhodesian news. On the other hand the scarcity of native labour is accentuated by a decrease in the number of stamps running at the Penhalonga and Rezende, and the forecast of a general decrease of gold production during the current month.

The Cam & Motor is being boomed, but it is a fine mine and opening up extremely well. The official statement is that on September 30 the ore reserve amounted to 700,000 tons, having an assay-value of £1,653,000. A correspondent in Rhodesia informs us that the mine is one of the best and has nearly a million tons of ore developed, but some time must elapse before it can be productive, as the experimental plant (a 10-ton unit) has only now been started. The shares are quoted at 38s. and there are 450,000 of them, so that the market valuation stands at £855,000. Of the £1,653,000 gross about £750,000 is likely to be profit. The Eileen Alannah, belonging to Willoughby's Consolidated, adjoins the Cam & Motor, and covers a part of the same ore-channel.

Sir William Milton, the Governor of Southern Rhodesia, has recently stated that the reconstituted Labour Bureau is to be put "on a firm financial basis." Sleeping sickness in Northeastern Rhodesia has now diminished to such a degree as to warrant relaxing the restrictions against recruiting in that part of the country. This improves the prospects for an increased supply of labour.

WEST AFRICA.—The gold output for September is officially stated to have been 26,717 ounces, valued at £109,039. Thus the output is slightly higher than in August and is therefore the maximum attained to date. An increase is recorded by the Abosso, Broomassie, Taquah, and Prestea. The last yielded £23,778 from 12,945 tons. As usual, the first place is held by the Ashanti Goldfields, with an output of £40,940 from 12,575 tons of ore. The Bibiani exhibits a progressive decrease. We note with pleasure that the Ancobra Dredging Co. did much better in September than heretofore.

From the Ashanti Goldfields comes the news that the Obuasi ore-shoot has been found in an easterly cross-cut 47 ft. from the No. 8 level southwest. The lode is 17 ft. thick and averages 3 oz. per ton. The persistence of this shoot greatly adds to the value of the property. The yield during October was 9750 oz., worth £41,422, and the profit, after every sort of expense is included, is estimated at £20,095.

The report of the Ancobra Dredging Company outlines the plan of operations recommended by Mr. S. J. Weis, the new manager. It involves the dredging of the old river-channel instead of the live stream. Careful drilling is to precede the erection of a new dredge. The scheme is well conceived and in accord with experience elsewhere.

The Rayfield Syndicate, with West Australian associations, is now operating in Nigerian tin areas, and has acquired additional ground of a most promising character on the advice of Mr. Walter Wethered. The Nigerian Corporation is preparing to exploit its properties in the Ninkada area. Enough tin is being obtained in the Bauchi district by 'calabashing' or hand-washing to cover the cost of the corporation's operations in Nigeria. Mr. H. O. Crighton, the manager, sends favourable reports in regard to results from prospecting. Again, the Berrida group of claims, owned by the Champion and Lucky Chance companies has been favourably inspected by Mr. L. H. L. Huddart, who

considers that the prospects justify the erection of a pumping-plant for the hydraulicking of the gravel. The area in question covers 47 square miles, of which only 49 acres has been tested as yet.

INDIA. — The chief shareholders in the Hutti (Nizam's) Gold Mines Co. have been in consultation with the board for the purpose of deciding the best way of raising the necessary capital for sinking a new shaft and erecting a slime-plant. As the company is now paying its way, owing to the discovery of ore at the 1840 ft. level, assaying 30 dwt. over 3 ft., it was considered advisable to postpone the decision until after the general meeting to be held in December. Attention has been attracted to the Kolar group by the announcement of interim dividends, which show that the profits at Mysore and Nundydroog are substantially greater with the same yield of gold. The chief reason for this is the recent reduction in the price of electric power, but several other economies have been effected by improvements in hauling and hoisting.

SIBERIA.—The recent voyage of the barquentine *Nimrod*, under command of Capt. G. V. Webster, from Liverpool, through the Arctic waters of the Kara sea, to the Yenesei and up that river to the interior of Siberia, is worthy of record. It may be possible to transport mining machinery by water from England to the mineral regions of northern Asia.

At the Spassky the output has now grown to 340 tons of copper per month, the second converter has been started at the smelter, and the mine reports are fairly satisfactory. It will be noted, however, that the bottom level exhibits impoverishment, and this is to be expected sooner or later, for the Spassky orebody affords a notable example of secondary enrichment. At the Atbasar the prospecting by drilling and the development by shaft-sinking tend fully to confirm the results obtained from earlier bore-holes. The problem of metallurgical treatment is now being carefully considered. Apparently a successful solution will depend on the degree to which the ore can be sorted before subjecting the discard to a concentrating process. The selected ore will be enriched from 12 to 18% copper by sorting, and will, of course, be smelted.

The Sissert estate, on which Mr. Vasili C. Pavlovsky secured an option recently, has been taken over by the firm of Gregori Benenson & Co. At present the output is at the rate of 125 to 130 tons of best selected copper per month. Additional plant will only be installed after the legal transfer of the property has been completed. No intention exists to offer the estate on the London market, at present.

The Lena Goldfields issues an annual report that must gratify the shareholders. A 3s. dividend is declared, making 6s. per share for the year. The proceeds from shares in its Russian subsidiary, the Lenskoie, gave a profit of £519,915, as against a book-value of only £68,820. On September 30 the Lena Goldfields still held 67% of the Lenskoie capital. The Lenskoie dividend for 1910 was £313,077. That for 1911 is yet to be declared. The output of gold during the year ending on September 30, 1911, was £1,619,406 from 881,001 cubic yards, showing a yield of 10 dwt. per yard, as against £1,551,849 from 748,896 cu. yd., and an average of 11·4 dwt. in 1910. The cost averaged 24·87 shillings per cubic yard, as against 37·61s. three years ago. Mr. C. M. Rolker estimates the reserve at 3,000,000 cubic yards besides 1,676,000 cu. yd. of probable pay-gravel. The company is capitalized at 1,405,000 shares, of which 1,122,216 are issued. They are quoted at £4⅝. The Consolidated Gold Fields of South Africa, formerly a large shareholder, has liquidated most of its holding. Two Russian directors are to join the board, indicating the growth of the Russian interest.

From Kyshtim comes a sad item of news. Horace H. Emrich, formerly of Denver, and

a metallurgist employed in the copper refinery of the Kyshtim Corporation, was shot through the window of his house by one of the workmen. The cause is not known, but it is a dastardly crime, all the more deplorable as the unfortunate victim leaves a young wife and two children.

AUSTRALASIA.—Our Melbourne correspondent sends us a clear account of the labour troubles at Mount Lyell. Since he despatched his letter, the engine-men have ceased work. This piece of news is specially bad, because it may cause the flooding of the mine. We understand, however, that Mr. Robert Sticht, manager, is confident of being able to keep the pumps going. The report for the half-year ended September 30 discloses a profit of £69,000, but under the circumstances the directors decided to distribute no dividend.

The researches into electric zinc metallurgy, initiated by some of the Broken Hill companies, appears to have advanced to a point warranting further steps. A shipment of about 1000 tons of typical ore is on its way from Broken Hill to Hohenlohe-Hütte, in Germany, and the ensuing tests are to be made under the joint observation of F. W. Harbord, H. W. Jepp, and A. E. Savage. An outline of the new process is given in 'Precis of Technology.' The dividend declared by the British Broken Hill Proprietary is the first since 1907. We understand that the manager estimates that fully 2,500,000 tons of ore are available. Better returns are expected to warrant an increase of the dividend to 4s. in the case of the North mine and an extra dividend by the Amalgamated Zinc company.

At Cloncurry the relations between the Mt. Elliott and Hampden-Cloncurry companies are becoming more friendly, and an amalgamation is likely to be announced shortly. Likewise the Oroya Exploration and Lake View companies are to be amalgamated.

MEXICO.—The Camp Bird may now be definitely ranged among Mexican issues, for the revenue of the company will henceforth come entirely from the Santa Gertrudis mine, at Pachuca. We understand that 400,000 shares are held in Paris. Two directors are to be added to the board so as to give French shareholders a representation. Mr. J. H. Hammond's resignation as consulting engineer is formally announced as dating from February last.

The Mexico of El Oro had a pleasant meeting of shareholders, and the statement made by Mr. André P. Griffiths, the consulting engineer, must have gratified those present. An increased dividend was promised for the next quarter, on the basis of better earnings. A gain of 35,000 tons in the ore reserve and promising prospects on the bottom level are recorded. The reserve of ore suffices to supply the mill for $2\frac{1}{2}$ years. If this should permit of dividends being paid for that time at the present rate of 16s. per annum, the total return now assured would represent 40s. per share on shares quoted at £$7\frac{1}{2}$. Having regard to the general impoverishment of the lodes in the El Oro district below the zone of oxidation, it would appear that speculators in Mexico of El Oro have a robust confidence in the future development of the mine.

The 300-ton mill of the San Francisco del Oro, at Parral, has started work, and is treating dump ore, awaiting the completion of the aerial tramway from the mine. The lead concentrate is sold locally, and the zinc middling is to be shipped to Trollhattan, Sweden, where it will be smelted electrically. The Trollhattan company has asked for a product roasted to 4% sulphur, instead of 8% as originally specified, so the furnaces are to be modified. Apparently there is some difficulty in connection with the roasting operation, for Mr. John H. Allen, of New York, has been asked to give his professional advice.

CANADA. — Our Toronto correspondent speaks of a revival of interest in Porcupine. We publish a timely article by Mr. H. H. Johnson, who has recently returned from Ontario. Swastika appears to be a promising

district, and a favourable official report has been issued on another new discovery at West Shining Tree, 70 miles north of Sudbury.

The official estimate of gold production in the Yukon Territory for the past season, as based on the royalties received by the Government, is $4,500,000, or about $250,000 in excess of last year. We publish some notes on dredging operations near Dawson, in the Klondyke valley, by Mr. F. L. Morris, who wrote from the spot. It is evident that the dredging of frozen ground in the Arctic goldfields has been solved successfully, and that the hydraulicking of bench deposits is also profitable, despite the shortness of the summer season. The technical experience obtained in the Yukon ought to be of great service to northern Siberia.

A find of gold ore is reported from Manitoba on the line of the Canadian Northern railway extension from Fort Alexander. Capt. E. A. Pelletier is responsible for the prospecting work that led to this new discovery. Only superficial tests have been made as yet.

United States.—Our New York correspondent sends an informing letter dealing with the Steel Corporation and the Tariff, two basic factors in American industrial progress. Interest in Alaska is increasing, although the active season is now closed. The Treadwell mines continue to do well in depth. A dredge on Buck creek, not far from Nome, has been doing good work on tin gravel, extracting enough to pay the first cost of the plant.

We publish some interesting notes on dredging in the Yukon by an engineer well versed in this branch of mining, attention to which has also been drawn by the interim report of the Natomas Consolidated, a Californian company in which English capital is interested. The data afforded are not in a form conveying the information really required, for the results from January 1, 1909, to June 30, 1911, are lumped together. However, it is noteworthy that the average cost of operating the dredges for the first six months of 1911 was 3·78 cents per cubic yard. Presumably this includes wear and tear, together with an allowance for replacement of parts. Dredges are perishable machines and the cost of them must be rapidly amortized. On such points the report is obscure. The net profit is given at $2,535,537 for the 18 months, on a gravel yielding 9·82 cents per cubic yard. It is planned to have 14 dredges in operation capable eventually of digging 27,000,000 cu. yd. per annum.

As a result of Mr. W. J. Loring's visit to the Mother Lode region of California, a California Exploration Co. has been organized by Bewick, Moreing & Co., with Mr. Albert Burch as local representative. An option has been taken on the Plymouth Consolidated, a famous old mine in Amador county, idle since 1888, and 1700 feet deep. The mine is credited with a past production of $7,000,000 in gold. It is now being equipped preparatory to being unwatered and developed.

Tin.—We have referred to the Nigerian mines and to one in the Transvaal. It remains to chronicle the flotation of the South Tronoh, adjacent to the famous Tronoh, in the Kinta valley, Malay States. The chairman is Mr. C. V. Thomas and among the engineers reporting are Messrs. Harry D. Griffiths and J. P. Rowe, the present and former managers of the Tronoh mine. It is proposed to employ a suction-dredge with a capacity of 1000 cubic yards per diem.

The Malay tin mines controlled by Mr. James Wickett of Redruth and his circle of friends in Cornwall afford an excellent example of low working cost. In the budget of reports just issued the Gopeng is the most interesting, for it is highly profitable. With an output of 426 tons of tin concentrate selling for £44,788, the mining cost was only £14,573; of the profit, £24,920 has been distributed as dividend at the rate of 35%, and the balance carried forward to swell the fund required for the extension of operations.

EDITORIAL

AT the last meeting of the Institution of Mining and Metallurgy it was announced that Mr. Edward Hooper had been selected as the next president. This will be pleasing news to the members generally and especially to the many friends of Mr. Hooper in distant parts of the world. The choice is one that will be cordially received, for the president-elect is a mining engineer who has worthily upheld the best traditions of the profession. We congratulate him on an honour deservedly won. His presidential address will, we understand, be delivered before the joint meeting of the Canadian Mining Institute and the Institution of Mining and Metallurgy on March 6 at Toronto.

MEMBERS of the Mining and Metallurgical Club in distant parts will be glad to know that the new Club is doing well. Those who reside in London will not need to be told that the Club is a success, for they will have been impressed with that pleasant fact by the attendance of members and the general convenience of the new institution. The luncheon hour brings together a remarkably representative gathering of professional men and others seriously engaged in mining or metallurgical affairs. When the annual meeting is convened, a new general committee will be elected for the ensuing year. Several members of the original committee have been compelled to resign owing to a change of residence to distant localities. Others have tendered their resignation with a view to establishing the principle of rotation. Thus one-third of the committee will not offer themselves for re-election, although remaining in hearty accord with the management and retaining a willingness to serve again after at least one year has elapsed. We take pleasure in making note of the fact that the idea of rotation has been put into effect, so that the general committee of the Club will be renewed in part every year while preserving a distinct continuity in its policy and management.

THE death of Joseph Pulitzer will have served to recall the fierce competition between his paper, the New York *World*, and the *Journal* of W. R. Hearst. The evil that men do lives after them. It was bad enough to have created a newspaper like the *World;* it was worse to have prepared a way for the *Journal* and the other journalistic prostitutes which Hearst has scattered over the North American continent. The exponents of crime and catastrophe may have contributed to the vividness and vivacity of American life, but they have effectually robbed the daily Press of its moral influence and have conduced to the aimless discontent and mental confusion of a large portion of the American people. For that we hate the memory of Pulitzer and the name of Hearst. We also detest them and their works in that they have spread their evil contagion to the sober newspaper on this side of the Atlantic, corrupting standards of old renown and robbing journalism of much of its former truth and dignity.

STRATTON'S INDEPENDENCE is a mine, the history of which, if faithfully related, would illustrate many of the factors that detract from the dignity of mining, for the story would include some romance, an excellent sample of reckless finance, a good deal of spoofery, joined with hard work and engineering skill. The last chapter is, on the whole, the most creditable, for it shows how the mine, when on the point of exhaustion, was resuscitated, first by tributing under-

ground and then by the beneficiation of the old dumps. How that is done is related by Mr. Philip Argall on another page. It is worthy of record that this mine has yielded $21,061,585 in 20 years, and has paid $7,393,656 in dividends. The latter should have been, and would have been, at least $10,000,000 if the mine had not been the victim of inflated capitalization and of the evils that follow in its train. The end, however, is not yet, for the mine and mill are still producing at the rate of $750,000 per annum. We trust that the honourable old age of this famous mineral discovery may be peacefully prolonged, as happens sometimes to men who have had a turbulent past.

THE CONTINUED FALL in Tanganyikas, or 'Tanks,' as that heavily watered stock is briefly designated on the Exchange, has given rise to many rumours concerning the share-holdings of Mr. Robert Williams and his co-directors. By reference to the records of Somerset House it would appear that most of these gentlemen have transferred large blocks of shares to others more willing to assume the risk. The appearance may reflect a fact, but we shall not be in haste to assume it, because it is not necessary for anyone to hold shares in his own name, except in regard to the small number required by law as a qualification for directorship. But we do regret that the law does not forbid directors and other persons acting as trustees from holding shares in any name but their own and render it a penal offence to make an arrangement calculated to obscure their exact financial participation in the enterprise. Directors should be compelled to adopt a frank attitude in this regard and any step likely to deceive those whom they represent—not their friends only, but all the shareholders—should be regarded as a sinister evasion. By this we do not mean that directors must necessarily be holders of large blocks of shares; on the contrary, it is a mistake to assume that a big speculator is the best man to control the policy of a company, save from a purely speculative standpoint. It is desirable, however, that they should not be in-and-out dealers in the shares of companies under their direction, because that subjects them to the obvious temptation of using public trust for a private purpose.

West Africa.

The fourth annual meeting of the West African Chamber of Mines, under the presidency of Lord Harris, gives a clue to those who wonder why the mining industry of the Gold Coast progresses so slowly. Two factors are prominent, namely, high cost of transport and inadequacy of labour. We regret to say that the Government of the Colony is largely responsible for both of these hindrances to industry. We have before us a schedule of railway rates, exhibiting a comparison between the freight charges on the Gold Coast Government Railway and the South African Railways, as taken from official tariffs. For a distance of 70 miles (with a proportionate increase for longer distances) it costs 24s. 3d. per ton to carry beef in barrels in South Africa and 82s. 6d. in West Africa. The same rates hold for battery screening, bolts and nuts, and cyanide. Chemicals are carried for 28s. in South Africa and 133s. 4d. in West Africa. The rate on flour is 13s. as against 82s. 6d. Preserved provisions, 24s. 3d. as against 133s. 4d. per ton. Imported coal is carried for 16s. 9d. to the Transvaal and for 9s. 6d. on the Gold Coast. This is one of the items in which the West African railway makes a favourable showing, for the reason that South Africa has coal mines and preferential rates are given in order to encourage domestic collieries. With this exception the comparison indicates that the Gold Coast Railway is acting on the lines of those American railway managements whose motto is "Charge

all that the freight will bear." In his speech Lord Harris stated that the earnings of the Gold Coast railway rose from 6% in 1909 to 9% in 1910. The treasurer of that transport system says in his report that "the remarkable prosperity of the Colony is due largely to agricultural development." This reads satirical to the mining operator who realizes bitterly that his prosperity is not worthy of mention and will be unmentionable until the Government adopts a more friendly attitude. Turning to the labour question, it appears that the Colonial Office has not met "the reasonable wishes" of the Chamber of Mines as regards the control and supervision of natives employed at the mines, for without some system of control the effort to recruit a sufficient supply from distant parts is doomed to failure. A revised draft of the Masters and Servants Act has been submitted, however, and it is hoped that it may be adopted. In these matters we are heartily in sympathy with the Chamber of Mines, which is acting in the best interests not only of the mining companies but of the Colony.

Camp Bird—Santa Gertrudis.

The Camp Bird and its vigorous off-shoot the Santa Gertrudis have given English shareholders a good run for their money. In these days of depression such a public meeting as that which marked the tenth annual gathering of the shareholders of Camp Bird, Ltd., affords a cheerful commentary on the profitable character of mining speculation. The chairman, Mr. Arthur M. Grenfell, had a good account to render, and he rendered it with confident assurance that those in the body of the hall would be gratified. In a sense, the occasion marked the end of the great mine in Colorado that formed the basis of the original undertaking. The Camp Bird does credit to all concerned, especially to the late Thomas F. Walsh, who developed it from a prospect, to Mr. Frederick W. Baker, who promoted the English company, and to Messrs. John W. Benson and William J. Cox, who successively had charge of the mining operations. To the original owner the mine yielded £900,000 and a profit of about £460,000 before he sold it in 1902 to a company registered in 1900. This company has now extracted £3,750,000 and has distributed dividends aggregating £1,500,000, besides a profit of £300,000 re-invested in the Santa Gertrudis. The price paid for the Camp Bird was £1,201,163, inclusive of £400,000 contingent on the profits, since paid in full. The company was capitalized for £1,100,000, but only 820,000 shares were first issued. The original shareholders have received 175% and retain an investment quoted at 150% more. This is one of the handsomest episodes in Anglo-American mining. Nor is it finished; for the Santa Gertrudis affords a most promising sequel. In January 1910 a controlling interest, amounting now to 81%, was bought in the Santa Gertrudis for £922,131. According to the latest estimate the ore reserve in this Mexican mine stands at 1,150,000 tons, from which a profit of £1,650,000 is expected. During the current financial year (to June 30, 1912) the Santa Gertrudis is expected to yield a profit of £200,000, and next year £350,000. In the meanwhile the current earnings will include £150,000, representing the last contribution from the Camp Bird, which will then be exhausted, unless an unexpected discovery should prolong its life. Earnings at £350,000 per annum are assured for 5 years from the ore already exposed in the Santa Gertrudis. When that is done the capital invested will have been more than returned. Further benefits must depend upon the development of this mine, which has responded nobly to every estimate as yet made. It is true the latest report indicates that on the 18th or bottom level the conditions are abnormal, the large width of medium-grade ore being replaced by a narrower lode, in two parts, one unusually rich and the other below the average of the levels

overhead. This development will be followed with keen interest, for it may presage a change in the character of the orebody. However, no immediate cause for anxiety exists, seeing that the average of the 11 feet of ore on the 18th is nearly twice as rich as that of the ore exposed on the 16th and 17th levels. Taking it all in all, the Camp Bird was a highly creditable mining issue and the Santa Gertrudis has the unquestioned merit of making money for the shareholders. This it is a pleasure to recognize, but it is our duty to enter a friendly protest against some of the features of the Santa Gertrudis affair. Thus the commissions paid to the consulting engineer, to the directors and their friends, reaches the lordly sum of £244,178. At the time the mine was acquired the consulting engineer and his associates received £119,178 for transferring the option they had secured on the property. Also an issue of 280,000 shares was guaranteed for 2s. 6d. per share by the Canadian Agency, with which the chairman and another director are identified. That made £35,000. Simultaneously £500,000 in debentures was underwritten for 5% by the Canadian Agency and by L. Hirsch & Co., with whom a third director is associated. That made £25,000 more. As to this underwriting at the time the mine was purchased, it may be allowed that it had to be done in a hurry, owing to the shortness of the option, as was fully explained by the chairman on December 30, 1910. He stated that the time available prevented the board from going "to third parties." The issue of £650,000 preferred was guaranteed by the chairman and his associates for 10%, making £65,000. The total is £244,178. Of course, all this money could not have been saved in any event; some commissions had to be paid, both on the optional purchase and for sundry underwritings. That is not the point raised. We submit that none of it should have gone to persons employed by the Camp Bird company. None of these particulars were kept secret. It is only fair to say that the shareholders and the public were informed concerning all of them even if they did not quite appreciate them. If they did, or if they do, they will most probably take the position that the directors have given them a good run for their money; they have had a chance to buy shares, debentures, and preferred shares; those who bought them have done well; and if the directors have made handsome profits, so have the shareholders. Again, the shareholders will agree with us that the affair has been managed with conspicuous skill. We refer to the episode only to protest against it being accepted as a precedent. We hold that directors are not privileged speculators, but trustees, representing not a group or a portion of the shareholders, but all the shareholders of the company. We can quote the chairman himself, when a well known operator asked that he and his friends should have representation on the board. He said: "I represent 20,000 shares, how many do you represent?" Mr. Grenfell replied: "I represent 820,000 shares [all the shares issued at that time], including your 20,000." That was a worthy answer. As trustees the directors should not act as brokers in their own interest; that seems obvious. The same applies to a consulting engineer. We do not question the good faith of any one concerned, but we do insist that those who act in a fiduciary capacity should avoid an equivocal position. A man cannot serve two masters when the interests of these two masters conflict. If directors are engaged in underwriting they should not be on the board of the company whose issues they underwrite for a profit. If the Santa Gertrudis had not done a bit better than there was warrant for expecting, the £244,000 paid in sundry commissions would have provoked a scandal. Nothing of the sort has happened; hence the subject can be discussed without ill-feeling. We place on record this polite and friendly protest in the best interests of the profession and of the industry.

Prospects in Rhodesia.

It is no misfortune to the mining industry of Rhodesia that the scribes who prepare financial gossip for the daily Press, especially those solemn journals issued on Sundays, have failed to create a boom in Rhodesian mining scrip. An untimely boom leaves melancholy wreckage. Conditions do not warrant an inflation of quotations. Neither the labour situation nor the condition of the mines themselves warrants more optimism than is already rampant. Several mines have opened up excellently, such as the Shamva, Lonely Reef, and Cam & Motor, but their satisfactory development has in every case been fully discounted by a rapid rise in the market valuation. It remains for even the best mines to fulfil the confident estimates already used freely as a basis for cheerful inflation. To us it appears patent that the Rhodesian operators—and a clever group they are—habitually put the cart before the horse; they force the market ahead of the mine; if all goes well, the favourable development has been discounted; if anything goes wrong, the public is a melancholy victim. Another feature of this market is the family party, whereby one company holds shares in other affiliated enterprises and uses the shareholder's money in speculative purchases, which are supposed by the unwary to represent public buying. We refer elsewhere to the disclosure of the fact that several companies have articles of association giving the directors a free hand in the creation of share-capital. The analysis of the holdings of many of the Rhodesian companies exhibits a weird medley of interests in diverse undertakings. Others spread themselves in a number of subsidiary companies, the practical control of the entire group remaining in the hands of one or two operators who find it easy, by purchases or sales of blocks of shares in the name of a company, to lift or lower quotations. This is one of the objections to the group system. The same game has been played on the Rand *ad nauseam*. We are glad to note the criticisms with which the recent Planet-Arcturus issue was received. The report accompanying the prospectus is unsigned, and therefore has no value beyond the vague endorsement of the Company that publishes it, namely, the Rhodesian Exploration & Development Co. According to the articles of association "the directors shall not be under any obligation before executing such agreements on behalf of the company to take any steps to ascertain the value of the said claims and properties, whether by local operations, independent inquiry, or by other means, and are hereby absolved from all further responsibility in regard thereto." This either means nothing or it means a distinct invasion of the rights of the proprietary, that is, the shareholders. Such financial legerdemain can do nothing but harm. It ought to put the public on its guard against participation in a blind gamble. Other flotations are imminent. We hope that they also will not give cause for further public protest. We join in protesting because anything of this sort handicaps the real business of mining, which is to make money by exploiting ore deposits, not simpletons. We turn therefore with pleasure to the registration of another development company, as a subsidiary of the British South Africa Company. This is "to assist in the more rapid development of Rhodesia" and so forth. We believe that it may, despite Lord Harris's sarcastic reference to the enterprise; we believe in it, not because it is another of the many companies organized for similar purposes, but because the first directors are Messrs. R. T. Bayliss, Walter McDermott, and J. Rochfort Maguire. The last of these gentlemen we know only as a vice-president of the Chartered Company, but the other two have been connected with practical mining for a lifetime. Our younger readers may associate them only with the City and its financial activities, but we remember when the Drumlummon was a famous

mine under Mr. Bayliss's resident management, and when the Silver Islet was producing astonishingly under the technical care of Mr. McDermott; since then their names have been associated with those of other mines no less productive, but the early days in Montana and Michigan gave both of them the essential grasp of mining that has been fundamental to their useful careers. Apart from technology, it is not too much to say that these two new Rhodesian operators have passed through the many vicissitudes of mining without detracting from their self-respect or from that which is willingly accorded to them by the members of the profession in which they have won a commanding position. We are glad to see this new departure in Rhodesia and deem it of the best augury for the future of that important mining region.

Waihi.

The regular reports from this mine indicate that some good ore has been found at the 10th level on the Empire lode, but no comprehensive examination has been made with a view to forecasting the future of the mine or the underlying causes of the sudden collapse that reduced the market value of the property from £2,750,000 to £1,500,000. The inspection made by Mr. G. A. Richard, the general manager of the Mt. Morgan company, wholly failed to meet the necessities of the case. For this, as we have said before, the scientific study of an expert geologist was requisite. It is well enough for the directors to say that they have confidence in the local management. That attitude may please those who are afraid that their shares may decline in value if intelligent curiosity be unduly sharpened; but it is not the attitude proper to men of business, who must face facts. The deterioration of the ore-bodies in the Waihi mine became evident just below the zone of oxidation and was known at the mine two years ago. In August 1910, the Geological Survey of New Zealand began a study of the locality, completing the field examination in March 1911. Though the detailed report is not yet available, it is reasonable to suppose that the local management would, in the ordinary course of events, obtain some idea of the conclusions reached by the officers of the Survey. If our conjecture be correct, then at least in March last an inkling of the facts, as they presented themselves to the geologists, should have been known to the management, by courtesy of whom the investigation was legally made possible. This being so, why was it deemed prudent to go before the general meeting, on May 15, with a report, which, for the occasion, was hopelessly incomplete? A definite pronouncement by a geological expert either confirming or contradicting the remarks concerning depth and impoverishment, which appeared in the manager's belated statement of January, should have been available. No such expert statement being available, we can only come to the conclusion that the directors thought that the shareholders had been sufficiently well informed, or that the local management was not prepared to admit that a geological examination could bring to light anything of value. The geological facts as we know them may be briefly stated.

The principal lode of the Waihi mine is the Martha. This has an outcrop on a hill, which is the top of an intrusive mass of dacite or quartz andesite. This hill is flanked by later extrusive rocks, in the form of rhyolite and andesite, which fill the hollows of the older eroded surface of the dacite. The Waihi lodes do not penetrate the rhyolite or the andesite; they are confined to the dacite, and their apex is at the old surface under the younger rock formation. Thus the ore-bearing area is limited in one direction. This has long been known. Another limitation, which a geological examination at any time within the last eighteen months would almost certainly have brought to light, must now be faced. Evidence exists that the mass of dacite traversed by the pro-

ductive lodes is surrounded by bedded flows of dacite in which the lodes are comparatively barren, although on Union hill some veins in this formation have been worked at a profit. Not only does the bedded dacite enclose the massive dacite in which the rich orebodies exist, but the productive rock becomes constricted in depth, the formation converging until a mere throat or vent is left for the massive dacite. In brief, at 1000 feet the productive formation is rather small for a mine. At that horizon the bedded dacite forms the footwall of the Martha lode and is adversely affected by it. The contrast between the two dacites is not defined, it is confused ; not even under the microscope is the difference easily discernible ; but the bedded rock has a coarser texture and is distinguished by interbedded seams of carbonaceous matter. For the miner it suffices to know that the one rock has proved favourable to the finding of rich ore while the other is as distinctly unfavourable. Petrographers may furnish a reason for this fact; it is probable that the cause is structural rather than chemical, and due to difference in time, the massive rock being a later phase of the same magma as that from which the bedded rock originated. Although such recondite matters may perplex a mine captain, it is not too much to say that the presence or absence of oxidation in a lode should not be beyond his ken. The limit of oxidation at Waihi is accompanied by a significant change : an increase of calcite in the ore. Where rich, in the zone of oxidation, the calcite is replaced by quartz. The lower limit of oxidation is passed on the Martha lode at about the 8th level. This fact should in itself have awakened intelligent curiosity, for, the world over, the miner anticipates this change with anxiety. No petrographer or geologist should be needed to tell an experienced manager that when oxidation ceases to be apparent, and when the composition of his lode undergoes a change in depth, that the future of his mine is at stake. Then he requires expert advice, and he should get it, if he can afford to pay for it. It so happens that the Waihi is one of the relatively few cases in which the geologist can give practical aid to the miner. That aid the management has neglected to obtain, and when it is obtained it will be in the guise of a delicately worded obituary.

The Sale of Tin.

During the last six months the price of tin has been maintained at an artificially high range of prices by the action of what is politely called in the city " certain Continental interests known as the Syndicate." The producers of tin ores have no reason to quarrel with speculative operations that are incidentally to their benefit, but on the other hand the consumers and the eventual users of the manifold materials having tin in their composition have been hit hard. However, the case of the producer and consumer does not worry the speculative middleman, and any re-organization of the terms and conditions of the Metal Exchange contracts comes only from the action of those members of the Exchange who have either been badly caught or find that their chance of doing speculative business is reduced to a minimum as long as the Syndicate retains its control of all tin that is officially recognized in Metal Exchange contracts. This is the reason why leading English firms have agitated for a widening of the scope of dealings in tin and have succeeded in obtaining a new official standard contract. It is opportune to explain this matter further for the benefit of those who are not familiar with the method of marketing tin, and we may parenthetically remark that the average mining man and metallurgist knows little or nothing of the buffetings received by tin or any other metal between the time it leaves the smelter and the time that it arrives at the works of the tin-plate manufacturer or of the makers of tin alloys. He is as innocent of

the source of all these variations of price as the average lady of the origin of the hobble-skirt or any other vagary of fashion. For a number of years the only dealings officially recorded on the London Metal Exchange have been those in tin from the Straits and Australia. These supplies are represented by the products of the Penang and Singapore smelters belonging to the Straits Trading Company, and by those from the Pyrmont at Sydney, the Mount Bischoff in Tasmania, and the Irvinebank in Queensland. The tin produced at these smelters comes from gravel mines where a concentrate is obtained remarkably free from other metals and accordingly is of high grade, averaging 99·9% or over. This pure material is greatly in demand by the tin-plate makers, who, in order to secure a bright, thin, and perfect coating, find it absolutely necessary to use nothing but the best qualities obtainable. We may take it that a large proportion of Straits and Australian tin is used in the manufacture of tin-plate. There are, however, many other producers of tin, and some brands are of equally high grade. The islands of Banka and Billiton, in the Dutch East Indies, yield a quality even higher than the Straits, averaging consistently 99·95%. These deposits are in the hands of the Dutch Government, which superintends the smelting and the marketing, so that transactions in Banka and Billiton do not come within the scope of the London Metal Exchange. The products of the English, German, and Chinese smelters have been debarred hitherto from official recognition in Metal Exchange contracts, and they are sold by private contract by the smelters direct or through the intermediary of individual members of the Exchange. The ores from which these brands are produced are of inferior quality to the Straits and Australian ores, and coming chiefly from lode mines contain other metals such as iron, arsenic, lead, antimony, wolfram, and titanium, some of which may be entirely eliminated by smelting and others reduced to as low a limit as is consistent with profitable operations. Bolivia is the largest producer of this class of tin ore, and those from Cornwall are of the same type. In our Précis of Technology we reprint a table prepared for the committee of the London Metal Exchange. It shows that the German and Cornish brands are usually above 99% and sometimes approach 99·9%, and that Chinese tin may contain so much lead and antimony as to bring the tin content down to 95¼%. Most of this quality of tin is sold to the manufacturers of alloys, such as bronze, britannia metal, pewter, and white metal. These alloys are composed variously of mixtures of tin with copper, lead, or antimony, so that the lower qualities of tin are as a rule as useful as the purer sorts. In addition to the brands of tin assayed for the committee, there are many other commercial brands of still lower content, some having as low a percentage as 85. These are quite acceptable to alloy makers. Many of them are made by the leading firms, but they are, of course, not sold under the same brand as their standard qualities. In this connection it is of interest to note that the two Cornish smelting firms, the Penpoll, and Williams, Harvey & Co. have recently erected subsidiary works near Liverpool, because that locality is more convenient for the transport of Bolivian ores and for the distribution of their products among alloy makers, a third advantage being the nearer proximity to the source of fuel.

Reverting again to the recent action of the Metal Exchange, we have to record that henceforward any tin made by the chief smelters and refiners assaying over 99% will be accepted in fulfilment of contracts. Tin over 99¾% will be held to be the 'standard' as regards quotations, and tin from 99 to 99¾% will be priced at £7 per ton less. In this way any dealer caught short will be able to make good his contracts by delivering Banka, Billiton, English, German, or Chinese tin, subject to

the limits above recited. At first sight it may be supposed by some people that the tin below 99¾% is being unduly penalized and that the mines and smelters will suffer. This is not so, however, for in all probability the present methods of disposing of tin will suffer no interference. As a matter of fact, the alteration in the official contract will make no difference to the producer and consumer, except that it will tend to prevent wild fluctuations in the price and occasional corners, seeing that the market operator will have more extensive resources from which to draw than has hitherto been possible. Apart from market considerations, we may also say that the move is perfectly logical. The old contract was quite out of date, for other parts of the world are now coming forward as producers. Bolivia has advanced and will continue to advance, and South Africa and Nigeria are coming forward. Then again the so-called Straits and Australian tin has not of recent years been derived solely from the near-by sources. For instance, the Mount Bischoff smelter treats custom ores of all sorts and qualities, and the Straits smelters receive ores from as far away as South Africa. Thus the name of the smelter from which the tin emanates is no longer a sure indication of the characteristics of the metal. Taking a broad view of the matter we consider that market operators, mines, producers, and consumers will equally benefit by the new ' standard ' contract.

The Gold Fields Report.

The earnings of big holding companies, such as the Consolidated Gold Fields of South Africa, necessarily reflect the general prosperity of the mining companies in which they retain an interest and of the share market in which they operate. Owing to the pronounced depression of the past financial year, it was expected that the Gold Fields would be compelled to cut the half-yearly dividend severely, but such is not the case, the reduction being only 5%, making the total for the year 6s. per ordinary share as against 7s. in 1909–'10 and in 1908–'09. The shrinkage in profits, however, is relatively greater, namely, from £993,400 to £792,900. Shares in companies have increased by £1,250,000; from £4,057,613 to £5,307,204. No list of assets is given; this we regret, as the distribution of such a company's financial activities is a valuable indication of the tread of industrial expansion. It is stated that realizations have taken place in Russian assets, and we assume that this refers to Lena Goldfields, which recently soared to a price amply justifying a realization. Owing to the transfer of the Rhodesian and American holdings to subsidiary development companies organized for that purpose, the parent company's report does not give much information on these matters. The Consolidated company's joint managers at Johannesburg give some valuable data as regards the labour supply. These confirm the views repeatedly expressed in our columns, namely, that the inadequacy of the supply is a constant hindrance to the expansion of the industry. From July 1910 to July 1911 the crushing capacity of the mills increased 369,967 tons per month, requiring an increase of 30,000 natives, but the number actually employed remained practically the same, being 181,514 in July 1910 and 180,898 in July 1911. However, it is claimed that the recruiting operations are more satisfactory and that the general efficiency of the native labour has been much improved, as is shown in terms of output per worker, and also by the slight decrease in working cost at the mines of the Gold Fields group despite the acknowledged shortage of labour. Mr. C. D. Leslie, as superintending engineer, gives information concerning the effort made to substitute machine-drills for hand-labour in stoping. Machines of the hammer type are advocated. Special steel is to be used. Three large electrically driven air-compressors have been

ordered. Among metallurgical items, we note the transfer of the amalgamating plates from the stamp-battery to the tube-mill circuit. This has been done in two of the big mills. Amalgamation has become a less important factor, thereby diminishing the amount of gold retained in the mill and also reducing the risk of loss by pilfering. The reference to the company's holdings in West Africa concludes with the significant statement that " the assistance hoped for " from the Colonial office in regard to recruiting and the discipline of native labourers has not been forthcoming. In conclusion, the report mentions oil interests in Trinidad and placer options in Colombia. Thus the wide geographical distribution of the Consolidated company's activities is emphasized. This feature is likely to be accentuated in the future, as an effort is undoubtedly being made to redress the declining value of the company's holdings on the Rand by engaging in new and profitable business in other countries. On the whole, the report indicates a policy marked by caution, but not lacking in enterprise.

Cyanidation in Colorado.

On another page we publish a lengthy and detailed article on the cyanide practice of the Stratton's Independence mill, at Cripple Creek, Colorado. This article is written by " the man behind the gun," that is, by the metallurgical engineer who designed both the plant and the method of treatment. The author, Mr. Philip Argall, needs no introduction to our readers, for he is one of the few who not only know how to do things, but also how to describe them when once they are done. Cyanidation is no new subject to him, and especially the effective use of cyanide solutions on the ores of the Cripple Creek district. These, of course, are remarkable on account of the tellurium with which the gold is associated. Ten years ago it was the local practice to subject these sulpho-telluride ores to roasting before leaching, not so much to drive off the tellurium, for gold telluride is sparingly soluble in cyanide, but to expedite the cyanidation by rendering the ores permeable to the solution. In preparing the ore for treatment, it was found advisable to crush finely, because coarsely crushed ore when roasted yielded particles of gold too large for rapid solution; on the other hand, the coarse gold was most amenable to amalgamation. Thus the Golden Cycle mill, erected in 1907, was designed to employ coarse crushing (to $\frac{3}{16}$ inch) followed by roasting, the roasted product yielding its coarse gold to amalgamation and its fine gold to cyanidation. At first amalgamating plates were used, but these subsequently were replaced by blankets, the blanketing being ground in amalgamating-pans. It was also ascertained that the dehydration of the quartz during roasting rendered the ore brittle and therefore easily pulverized. This scheme of treatment was well adapted to ores of medium grade, as viewed locally, namely, about 8 dwt. per ton, but was unsuitable for anything poorer, on account of the high cost of roasting. Thus the old filling in the mines and the old dumps on the surface could not be beneficiated. The roasting alone entailed a cost of $1·75 per ton. Thereupon further experiments were made with a view to separating the sulpho-tellurides, representing only 3% of the ore, and submitting that small part of the output to roasting. The concentrate thus eliminated became readily marketable at the smelters, so that it underwent no further treatment at the mine. The remainder of the ore is crushed fine and concentrated on tables, but dilute cyanide solution is used in lieu of water. Thus from the moment the ore undergoes crushing the gold in it is exposed to solvent action. The details of this latest phase of Colorado practice are given in Mr. Argall's article, describing the mill erected in 1908 and the successful work accomplished since. It suffices to say that this mill is paying 10% on the reduced capital of the company by treating

material that elsewhere in the district of Cripple Creek is used for ballast, by reason of old contracts for easement and right-of-way, whereby the railway company is compelled to remove 'waste' from the ore-sorting sheds. This serves to emphasize the character of the metallurgical feat that has put money into the pockets of British shareholders and afforded a striking demonstration of the efficiency of the cyanide process when placed in skilful hands.

The Imperial College Union.

On the opposite page we reproduce the photograph of the quarters or club-house provided for the Union or consolidation of affiliated student societies in the Imperial College of Science and Technology, at South Kensington. Primarily this will interest our readers because the Imperial College now includes the Royal School of Mines, together with the Royal College of Science and Central Technical College. In April 1909 the Governors of the Imperial College allocated a sum of £10,000 for the purpose of erecting a building or club-house for the student organizations, for old students, and for the members of the teaching staff in the three constituent departments. Subsequently the grant was increased to £17,000. Thereupon Sir Aston Webb was commissioned to design a building, the erection of which was completed a year ago. In this building provision was made for a restaurant capable of seating 150 persons, a smoking room of equal size, a library and gymnasium, together with two smaller sitting-rooms for the use of women students and professors respectively. While, as stated, the Governors provided the funds for erecting the building, it was left to the members and their friends to raise the money needed to furnish the club-house. This was done by making a public appeal to old students of the three schools, the hope being to raise enough money to complete the furnishing and also to purchase separate playing-fields. The last item had however to be shelved for the present as only £1600 was subscribed, that is, just enough to purchase furniture and other essentials. But the subscription list is not closed and it is hoped that further donations will be forthcoming; these should be sent to the Right Hon. Arthur Dyke Acland, at the Imperial College, or to Mr. Arthur C. Claudet, at 6, Coleman St., E.C. Graduates in distant countries will be glad to hear of the Union and its quarters, and will, we trust, put their hands in their pockets effectively. The financial status of the enterprise is sound, for to the surplus of £700 at the bank may be added an income of £850 drawn from regular student subscriptions, which are paid with the fees for tuition. Thus the future is assured. It remains to tender hearty congratulations to those who have worked loyally toward a useful purpose, and among the younger men we may mention Mr. P. Litherland Teed, who has earnestly represented the hopes and ambitions of the student body. Old students are invited to visit the club-house, which is intended, among other things, to bring together present and past students, as well as students and teachers, in a common effort to further the highest ideals of a technical education.

On November 3 the opening ceremony took place, Mr. G. S. M. Taylor, as president of the Union, being in the chair. The proceedings began with a charming and effective speech by Sir Thomas Holland, who was followed by Mr. Acland, to whom the completion of the enterprise is so largely due. A spirit of co-operation and mutual goodwill was earnestly expressed, and it was obvious that those in control of the Imperial College have now a confident expectation of bringing together the discordant elements out of which a great educational institution has been evolved. The unifying and consolidating influence of a common meeting-place for all the students and staff was urgently needed. It has

THE IMPERIAL COLLEGE UNION.

now been supplied. We hope that former students will visit the Union. We hope also that the next Royal School of Mines dinner will be held there and that the occasion may be used to create further interest in the undertaking. It is worthy of enthusiastic support. We give ours with keen pleasure.

Impoverishment in Depth.

The East Rand fiasco continues to hold the stage. Although we regret the injury it has done to public confidence, we believe that the only way to turn the episode to good account is to probe it to the bottom, in order thereby to obtain such warning and guidance as may prevent a repetition of similar blunders in the future. To make a mistake is regrettable; to fail to learn from mistakes is damnable. Therefore we turn with keen interest to a letter in *The Financial Times* quoting (from the Johannesburg *Evening Chronicle*) the evidence given in 1907 by Mr. Frederick Hellmann before the Mining Industry Commission at Johannesburg. Mr. Hellmann was at that time the general manager of the East Rand Proprietary. His evidence referred to the prospects of the big group of mines under his charge and incidentally to the general question of impoverishment of ore in depth as it affected the future of the Rand mining industry. The evidence was given *in camera* but it was published in a Blue Book and should have been known to the directors of the East Rand Proprietary before the consolidated company was floated in 1908. It argues that the technical Press at Johannesburg must have been curiously complacent to market operators not to have given publicity to testimony of such importance. For we know Mr. Hellmann and his qualifications; we therefore do not hesitate to say that we have the highest respect for his opinion on such a fundamental question. In brief, he testified that a decrease of gold content was "most marked" in "all the mines" with which he was acquainted on the Rand. Even in the Driefontein "the poor zone was much more extensive" than he had expected. On cross-examination, he said frankly: "I refer to the Rand generally. I have been around, and I know the conditions of the deep levels, and I can say generally that you have got a falling grade in depth, and that it is most natural it should be so. You would expect it from the start from the method of deposition. In depth any mine gets poor. That is the history of every gold mine in the world." In answering Mr. Cresswell, he insisted on this view and told his questioner that he also must be aware of it, despite any disclaimer. "Anyhow," Mr. Hellmann concluded, "I know it, and I give it as my evidence."

The obviously unstudied manner of expressing himself is convincing as regards the sincerity of the witness, even to anyone ignorant of his high reputation as an engineer. Engineering is based on the recognition of facts. Honest thinking, as well as honest acting, is essential to scientific operations. Here we have a highly competent man saying what he thinks, not recklessly, but after mature consideration and a fullness of experience amply warranting a decisive answer to one of the basic problems of precious-metal mining. Yet in March 1910 both Sir George Farrar and Mr. Lionel Phillips testified to the share holders of the East Rand Proprietary that the Angelo Deep had "added to the evidence that the Witwatersrand series were not decreasing in value" in depth. Again, it was stated by Mr. Phillips that "if they excluded the surface area down to 200 or 300 feet, there seemed to be no evidence whatever that the gold contents at the deepest levels were not fully as high as they were at the surface, or within 300 ft. of the actual surface." Manifestly, the testimony given by Mr. Hellmann must have been known to these gentlemen, yet they said that "no evidence whatever"

existed to dispute their confident but amateurish statements. Needless to say, on such a technical matter the opinion of an experienced mining engineer is worth that of a dozen directors and financiers. We are not lacking in respect for the ability and experience of such men as Sir George Farrar and Mr. Lionel Phillips in business affairs, in politics, in sport, even in warfare, but when it comes to a basic technical problem they are merely intelligent spectators. We are compelled therefore to blame those, whoever they may be, to whom is due the concealment of Mr. Hellmann's testimony, and we regret that a very pardonable loyalty should have made it proper for him to withhold publicity from his views on so important a question. However, the evidence has now seen the light of day, and it remains to give heed to it. Naturally, if we had been aware of it three months ago when discussing the same subject in connection with Mr. C. O. Schmitt's paper, and Mr. H. F. Marriott's discussion thereof, we would have made appropriate use of such weighty testimony. We must now reiterate the request for a publication of the evidence on which Mr. Marriott asserted that "the assay-values of samples of actual reef-widths taken throughout all the mines," of the group controlled by the Central Mining Corporation, showed "no substantial evidence" of general deterioration in the richness of the ore with increasing depth. It may be asked why we insist on Mr. Marriott submitting detailed evidence, when we do not demand it from Mr. Hellmann, as an earlier witness. The answer is that impoverishment in depth is a world-wide fact; the rule needs no proof; it is the exception that requires demonstration. Such exceptions have been known for a short time and for a limited depth, only however eventually to comply with general experience and to be proved local variants from a rule that is indelibly burnt into the memory of the miner. The recognition of it will do no harm save to irresponsible finance and reckless speculation. Mining is based on facts. Neither the industry nor the public that finds the money for it will suffer by smashing a fallacy that is the first falsehood of the flam-buoyant promoter and the last resort of the perplexed financier.

Meticulous Estimates.

On previous occasions we have referred to the air of precision imparted to estimates, necessarily approximate, by giving them in figures to several decimal points. All estimates of ore in reserve underground, that is, ore only visible and measurable in part, are subject to error within a reasonable limit. To state the tonnage or the assay-value in units suggesting excessive accuracy is misleading to the public. By experienced professional men it is deemed merely absurd. We object to it because it is farcical and therefore calculated to deceive shareholders. Not long ago we animadverted on Mr. H. A. Piper's use of three decimals in giving the penny-weight-contents of the reserve in the Globe & Phœnix gold mine. We note that the latest estimate gives 35·728 dwt. as "the average value," meaning thereby the average gold-content, per ton. When engineers can estimate to a nicety expressed by one in a thousand parts of a pennyweight of gold, we shall be the first to applaud their skill. At present the decimal points indicate merely the fact that one quantity divided by another has yielded a fractional quotient. In the Natomas interim report Mr. C. M. Rolker gives the average value of dredging land in California as 9·9395 cents per cubic yard and the average cost as 4·0889 cents. We ask whether his statement would not be as truthful if the value were put down at 10 cents and the cost at 4 cents? Of course, neither he nor any other engineer is able to estimate gravel any closer than in cents per yard; it is merely pretentious and misleading to write or

speak in minute subdivisions. If the Natomas yields 10-cent gravel at a cost of 4 cents per cubic yard, as is quite likely, we shall be the first to give Mr. Rolker credit for an accurate estimate. If, however, engineers will persist in a mock-accuracy that disdains round figures we shall not be surprised if shareholders and the public generally hold them to estimates of a meticulous exactitude. For example, Mr. Rolker's estimate of January 1909 gave the gross assay-value as 9·9395 cents, but the gravel actually dredged to June 30, 1911, yielded only 9·8260 cents; again, his earlier estimate gave 4·0889 cents as the average cost but the actual operations show a cost of 4·1340 cents per cubic yard. Evidently his estimates were in error to the extent of 0·1135 c. for the assay-value, while that of cost was too low by 0·0451 c. per cubic yard. This is a most serious discrepancy and warrants the appointment of a committee of investigation! However, speaking seriously, we deem it a pity that intelligent men like Messrs. Piper and Rolker, for example, should lend themselves to make-believe of any sort, especially of a kind likely to hurt the profession to which they belong.

Official Opinions.

In a series of articles appearing in *The Times* a well informed writer has described general conditions in Nigeria, and has given some account of the tin mines. Incidentally he condemns "the practice of Government officials identifying themselves with financial syndicates to exploit the country they have participated in administering." In one case, it is true, an experienced ex-official prevented a fraudulent promotion. We agree, however, with *The Times* that this isolated case does not lessen our dislike of an objectionable practice, which usually lends itself "to impair the very high standard of public service of which Great Britain rightly makes a boast. Indeed, our experience in several of the over-seas Dominions all goes to prove that the less Government or State officials have to say about the value of mines the better for all concerned. It is a fallacy to suppose that Wardens, Inspectors of Mines, Mineral Surveyors, Government Geologists, and the like, are *ex officio* good judges of mines from either a speculative or an investment point of view. Naturally they are prejudiced by their desire to stimulate local industry and by their wish to aid local owners or promoters of mines. It is no part of their duty to express opinions on the earning power of commercial enterprises, save occasionally to prevent a gross scandal. The incidental comment appearing in an official report should not be rated as the serious appraisal of a complex undertaking. Gratuitous opinions on mines are worth what they cost. The type of man in the Government service is usually honourable and well intentioned but he is rarely equipped by training or experience for the difficult business of mine valuation. When he is not honourable, and merely lends himself to unscrupulous promoters, he is pestilential. Even the scientific members of a Government service, such as the officers of the Geological Survey, are rarely qualified for the task to which we refer. They have not had charge of mines, they may not know how to take an accurate sample, they know little about metallurgical details, they may have ideas, usually optimistic, on the continuity of ore deposits; but such ideas are apt to be detached from the earning of dividends, which is the aim of practical mining. Exceptions do exist, of course. We would like to name them. They are men who have had a training as mining engineers before they joined the Government service and while in that service they have continued to develop a proper appreciation of economic essentials. But in such cases it is the individual and not the office that makes him a reliable appraiser of mines. Finally, we come to the worst phase of a bad practice, when even Administrators of Provinces,

Governors of States, and Premiers of Colonial Governments undertake to express opinions, which, of course, are eagerly exploited by those whose business it is to mine in the pockets of an unwary public. The worst example of that sort of thing was the wild utterance of the Premier of Western Australia, who spoke in 1910 of the Bullfinch discovery in terms so exaggerated as to precipitate a premature boom that led to the squandering of large sums of money, the building of an expensive branch railway, and the flotation of companies that have already proved a scandalous failure. That unsavoury episode should stand as a warning and a reminder of the basic fact that the only person whose appraisal of a mine is to be considered seriously is a competent practitioner to whom a fee or retainer has been paid for making the careful investigation essential to a trustworthy valuation.

Origin of Petroleum.

Early this year, Mr. A. Beeby Thompson contributed a valuable paper to the Institution of Mining and Metallurgy on the geographical distribution and geological occurrence of petroleum throughout the world. He refrained from entering into a discussion as to its origin and genesis, partly because he did not wish to make his paper too lengthy, and partly because he felt that he had not sufficient data upon which to found a theory. Many of his auditors regretted that he had omitted this part of the subject, for the double reason that it would have afforded an excellent subject of debate, and that a discussion might help to elucidate a problem at present wrapped in the deepest mystery. The deficiency has been made good by Mr. Eugene Coste, of Canada, who presented a highly combative paper at the meeting of the Institution held last month. Mr. Coste's views on the subject are well known, for he has been the champion of the inorganic theory for ten years, and we abstracted an excellent paper by him in our issue of September 1909. Mr. Coste's style of writing is not such as to induce the full confidence of his readers, for he starts with the assumption that the views of his opponents and supporters of the organic theory are "fallacies." This attitude is apt to raise personal friction and to remove the discussion from the calm atmosphere that is desirable at a geological debate. When in a minority, it is not advisable to proclaim loudly that the opposing party is radically wrong. We all remember the Irishman on the jury, who, after arguing for hours, exclaimed: "Eleven more obstinate men I never met in my life." But when we listened to Mr. Coste, his genial personality and naive method of diction removed any antagonism to his style of argument that might have been present in our minds, and his audience welcomed him as a speaker even if they did not agree with his views. Accordingly, the discussion was friendly and sympathetic; contrary arguments were urged in detail and sometimes forcibly, but without giving offence. The paper and the discussion will afford English readers a symposium of opinions on the subject of the origin of petroleum. In addition, we should advise a perusal of Mr. Raymond S. Blatchley's monograph that appears in the Illinois Geological Survey's yearbook, as this is perhaps the best balanced statement of our present knowledge. We gave a short précis of Mr. Blatchley's writings in our issue of April last.

For the benefit of the general reader, it is opportune to state briefly the views generally held as to the origin of petroleum, and we may preface our remarks by saying that natural conditions and phenomena afford little or no clue to the mystery. The upholders of the organic theory insist on general principles that as petroleum consists of organic compounds it must have had an organic origin. The word 'organic' in chemistry is used to describe any substance composed of carbon and hydrogen, with sometimes nitrogen, oxygen, and sulphur,

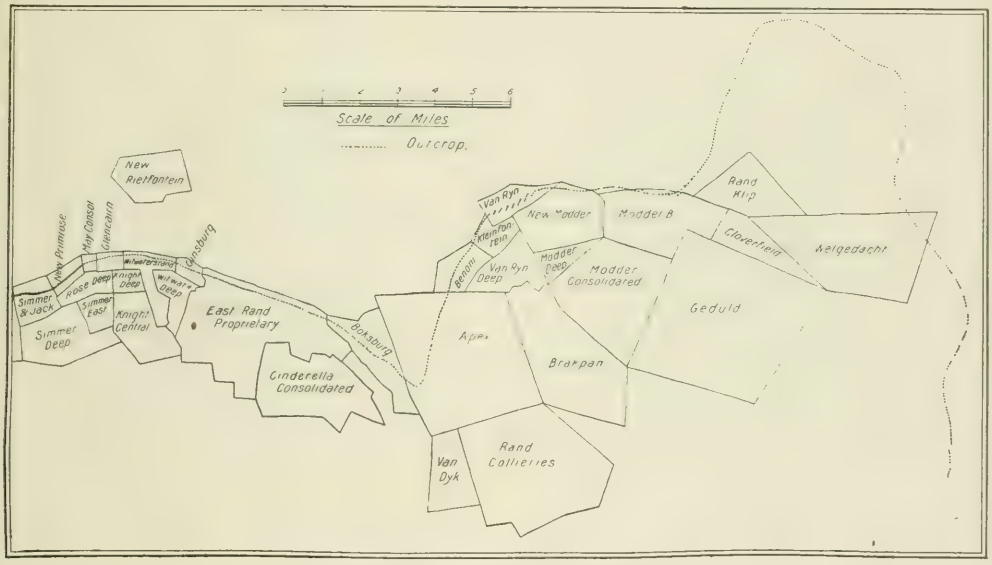
and it has been borrowed from the vocabulary of biology, for any such compound was always supposed to have its origin in or from a substance forming part of vegetal or animal life. Under such circumstances it was inadmissible to suppose that the hydrocarbon compounds constituting petroleum could have any other than an organic source. The fact that solid, liquid, and gaseous hydrocarbons can be produced by the distillation under heat and pressure of wood and coal was considered to be a corroborative circumstance, the importance of which was irrefutable. The occurrence of petroleum geologically favoured the theory, for most of it is found in Tertiary strata, and therefore could have been formed by the distillation of the earlier coal deposits. Then again the fact that the volatile constituents of the original vegetal deposits forming coal have been removed in varying degree may be used as evidence that some distillation has taken place. A specific argument advanced is that the oil-shales were formed by the decay of vegetal and animal matter in muddy water. These form the general line of reasoning adopted by the supporters of the organic theory. On the other hand, the evidence in favour of the opposite view is more specific and detached. It is shown that petroleum is found in many other rocks than the Tertiary; indeed wells have been sunk even in ancient gneisses. The number of varying occurrences shows that the distribution of petroleum is geographical rather than geological. To the upholders of the inorganic theory the fact that most of the oil is found in the sandstones and shales of the Tertiary period has no bearing on the question of the ultimate genesis of the oil; they argue that these beds happen to act as reservoirs because they are porous and can retain the oil by capillary absorption or because they are overlain by impervious strata. The most important argument, however, is supplied by the recent discoveries of the synthesis of organic compounds from the separate elements. As already mentioned, all organic compounds were supposed to come from living bodies, but this principle has been upset by the manufacture of acetylene by the reaction of calcium carbide on water. It is easily conceivable that carbides may be formed at great depths and that their contact with water will generate hydrocarbons of all sorts. Directly this is admitted we have a basis for a provisional theory of the inorganic origin of hydrocarbons. On this assumption, hydrocarbons have been continually formed from the earliest geological ages and are still being formed, slowly, it may be, but steadily and regularly. Who knows but that this reaction may have been the primordial source of all organic compounds on the face of the earth? The theory is in harmony with the observations of investigators who have detected hydrocarbon gases in volcanic emanations; and incidentally we may mention that the contact of sulphurous and hydrocarbon vapours would cause the deposits of native sulphur found at volcanoes and elsewhere. The inorganic theory does not interfere totally with that of organic origin, for the latter would still hold good as far as a secondary and perhaps greater formation of oil by distillation of coal is concerned. To all these arguments the organic party reply by asking whence came the carbon that combined with the metals to form carbides, and thus we arrive ultimately at the problem as to whether the first hydrocarbons or organic compounds were produced by inorganic synthesis, or whether the formation of the myriads of combinations of carbon with hydrogen, oxygen, and nitrogen was first made possible by the introduction of that mysterious element 'life' into the earth. We have refrained from burdening our readers with the mass of evidence brought forward by both sides in this controversy as to the origin of oil; all we desire to do is to present the main arguments in such a way that the average man may obtain a general idea of the subject.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

The Brakpan Mine was the subject of an interesting visit on September 30 by members of the South African Institute of Engineers. The surface works consist of the latest appliances for the hoisting, handling, and treatment of ore. Everything with the exception of the air-compressor is driven by electricity. Two types of electric hoists are in use, one driven direct by a three-phase alternating-current motor for hoisting ore, and the other driven on the Ward-Leonard system for hoisting men, jumpers, and timber. The latter is supposed to ensure greater safety, the liquid controllers of the three-phase hoist being a weak point. In both systems a great deal depends on the brakes, which, at the Brakpan mine, are of the post type, operated by dead weights and relieved by compressed-air cylinders. In case the power, due to a break-down or thunderstorm, were suddenly cut off, the brakes would have to be depended-on entirely to prevent the skips getting out of hand—a serious matter, if it so happened that men were being hoisted at the time. The battery consists of 160 stamps, each of about 2000 lb., 140 of them being driven by electric motors in sets of ten, with the result that there is continual trouble, due to breaking of cam-shafts. This was apparently anticipated, for 20 stamps are run in sets of five, so that broken cam-shafts can be used over again. The advantage of running the stamps thus is hardly apparent, seeing that from past experience the difficulty of getting the cam-shafts to stand the strain is well known. The result was noticeable at the time of the visit, when 6 cam-shafts were seen to be broken. In these cases only 5 stamps, out of each set of 10, were running. The cyanide works contain examples of the latest practice. In this department was seen a Butters filter-plant, Pachuca vats, and Merrill filter-presses as opposed to the old fashioned extractor-box. Although a more complicated arrangement, yet the increased extraction of gold from the ore should pay handsomely for the extra capital cost and maintenance. The idea conveyed during the inspection of an up-to-date surface plant on the Rand is that with the increase of labour-saving appliances, the tendency is to introduce mechanical arrangements of greater and greater complexity, with the result that the capital expenditure is increased and the cost of maintenance also. The relative increase of the latter on the new plants cannot



EASTERN PORTION OF THE RAND.

yet be ascertained, but it will be an important item in a few years on many of the present up-to-date surface equipments.

New Modderfontein.—This mine affords an interesting technical study, as in all departments it contains examples of the latest practice in gold mining. Underground there is the combination of old Rand practice with colliery methods, the latter consisting of the sinking of a circular shaft, already down to a depth of 588 ft., together with the new 'big-block' scheme of development. This big-block system is on an even more extensive scale on the adjoining mine, the Modderfontein B, where the size of the blocks is about 1000 ft. on the dip by 750 ft. on the strike. The circular shaft, in conjunction with mechanical ventilation, is an improvement on the old rectangular shafts, and, with the use of cages and the hoisting of trucks from one level, it will be possible to increase the speed of hoisting. A large shaft-pillar will have to be left. The cost of sinking is apparently greater than that of rectangular shafts. The new 'big-block' scheme of development is an innovation, the advantage of which has yet to be proved. It will be interesting to see how the estimated ore reserves will agree with what is actually obtained. Assuming that the large 1000 by 750 ft. blocks are worked on a modified long-wall system, it is difficult to see how a face 1000 ft. long will be kept in good shape for efficient stoping, when numerous dikes and faults may be encountered and also areas of unprofitable ground, which will necessitate intermediate drifts to cut large pillars for safety and other purposes. The conditions under which the ground is broken in a stope on this goldfield, where high explosives are used, scattering the broken ore over large areas and making it difficult to pack waste close to the face, are altogether different from those obtaining at a long-wall face in a colliery, where, for example, coal-cutting machines are used, waste being packed close to the face, the coal being merely broken down, without but little scattering action. These new methods underground must therefore be regarded in the light of an experiment, and it seems possible that several modifications will eventually be adopted. As to the mining policy adopted at the New Modderfontein, the chairman at the general meeting of the company stated that neither the 'selective method' nor the 'wholesale method' was strictly adhered to, but it would appear that the former method was in favour during the past year, as although the working cost per ton milled increased from 15s. 10d. to 17s. 4d., the recovery value of the ore also increased from 26s. 4d. to 28s. 6d. per ton. As to the surface arrangements, a Butters filter-plant has been installed and the important point of providing accommodation for the married employees has received careful attention.

[Our correspondent's view that the increase in yield and cost prove the adoption of the selective method is not confirmed by the report of the directors and engineers. The reason for the greater yield is officially stated to be the discovery of much high-grade ore in the eastern part of the mine, while the extra cost is attributed to the amount of money spent in improving the methods of developing and handling the ore and to the large amount of development work done. Details with regard to this matter will be found in other pages of this issue, in the abstracts of company reports, and in the reports of company meetings.—EDITOR].

The East Rand Proprietary commission of enquiry was appointed in somewhat of a hurry and regardless of the existing laws on the subject. The Government took it upon themselves to appoint a commission of three members, of which the Government Mining Engineer was one, without the necessary application to do so from shareholders holding at least one-tenth of the total number of shares. The mining company fought the case and as a result the Government has cancelled the appointment of the first commission on the understanding that an application for a commission of enquiry shall come from shareholders holding the requisite number of shares, petitioning that an enquiry shall be held to look into the affairs of the company. The directors of the company have agreed to this. It is difficult to see what the commission will be able to discover wrong in the running of the East Rand Proprietary mining group, except that it has been found impossible to keep up a profit, which was estimated at too high a figure in the first instance, and in the meantime as the grade of the mine has not improved the profit has of necessity to be reduced.

Rand Water Board.—The increased demand by the mines for water from the municipal supply has risen from 1·03 million gallons per day in July 1909, to 4·99 million gallons per day in July 1911, with the result that the Board found themselves supplying to their consumers 0·1 million gallons more than they were obtaining from all their sources of supply. The mines at present have therefore to economize as much as possible in this direc-

tion. The tonnage milled on the Rand in July 1909 was 1,785,450, against 2,095,220 milled in July 1911, an increase of 309,770 tons per month. In July 1909 the water supplied by the Rand Water Board was being consumed at the rate of about 18 gallons per ton milled, whereas the water supplied in July 1911 was being consumed at the rate of about 70 gallons per ton milled. Apart from the fact that the tonnage milled per month has increased in the last two years by 309,770 tons, more water being naturally required for that reason, there is still the increased quantity per ton milled to be accounted for. During the year 1910 the average quantity of water used was about 330 gallons per ton milled, while in 1911 the quantity has risen to about 530 gallons, of which the Water Board supplies about 12%. The increase is due in a measure to a greater consumption for domestic purposes, but is chiefly traceable to coarse crushing by stamps, in conjunction with secondary crushing by tube-mills. In many mines tube-mills have been added where the arrangement of the original milling plant has been unsuited for them; this applies chiefly to the original mill-launders, the fall of which was sufficient for the flow of pulp passing through screens of small mesh, but insufficient for transporting pulp that has passed through the coarser screens now used. To overcome this difficulty more water is used to flush out launders and prevent the overflow of pulp. It is therefore probable that for the future the amount of water used per ton milled will not increase at the same rate. As the old-fashioned plants die out and newer ones take their place, a saving in water should result.

White Labour.—The frequent changes among the white workers on the mines of the Rand is a subject that has been discussed by Dr. Donald MacAulay, and admitted by Lionel Phillips. The managers of the mines are blamed for this instability of employment. As it affects the managers equally with the rest of the personnel of the mines, it is wrong to place the blame on them, for the managers are just as uncertain of retaining their positions as are their subordinates. The shifting usually begins with a change in consulting engineers, who appoint their own managers. The managers, in their turn, are anxious, as are also the consulting engineers, to make a name for themselves by running the mines to best advantage and, in so doing, to obtain the best results for the shareholders. No group of mines nor any single mine can be run by one man alone; the results obtained depend on the ability and *esprit de corps* of all employed. When new consulting engineers are appointed, if they come from other parts of the world, they naturally bring their own men, from their own districts; if, on the other hand, they are men who have worked their way

TAILING-ELEVATOR AND CYANIDE VATS AT THE CITY DEEP MINE.

locally, they will appoint local men, of whose trustworthiness they are certain. In turn the subordinates introduce their own men, and thus a change among those at the head of affairs is reflected throughout the ranks of white employees, even to the unskilled labourers. Changes in the personnel of a mine or a group of mines may or may not lead to more efficient working. Employees who have held positions for long periods may have got into grooves, whereas it is usual for "a new broom to sweep clean." The advantages of a change in management depend entirely on the judgment used in making such changes. Instability militates against the continuity of a definite policy, but on the other hand when there is the possibility of promotion there is greater keenness among employees, provided promotion is known to go by merit.

The Tailing-Wheel is becoming a thing of the past, its place being taken by centrifugal pumps chiefly of the Robeson-Davidson type. It often appears that, in the laying out of a mine, fashion is followed regardless of any assured improvement. Much money might be saved if the older mines were regarded as experimental works from which sound deductions may be derived as to the relative merits of various appliances for doing the same work. A case in point is that of the increased use of the centrifugal pump instead of the tailing-wheel for elevating mill-pulp. The advantages of the tailing-wheel are its low working cost, slow speed, and saving of power required to elevate the pulp; against this we have its high first cost. In these days when everything is driven by electricity, if the power goes off, no matter whether pumps or tailing-wheel are used, a stoppage will ensue. A tailing-wheel, with a pump as a stand-by, is the most efficient means of elevating mill-pulp up to the usual heights required, of about 50 ft., as it will use about 50% less power than a centrifugal pump to do the same amount of useful work, apart from the question of maintenance. A tailing-wheel of the latest pattern, 55 ft. diam., has been erected at the Roodepoort United Main Reef; this is built of steel, on the principle of the bicycle wheel, and is driven by a 50 hp. motor, through the necessary gearing, to reduce the speed to the required limit.

[The inspectors finally appointed to investigate the East Rand affair are Harry O. Buckle, a chief magistrate, P. Ross Frames, managing director of the Premier diamond mine, and R. N. Kotze, the Government Mining Engineer. Their report ought to be published during the current month.—EDITOR].

SAN FRANCISCO.

American Institute.—The topic of greatest interest on the Pacific Coast during October was the visit of the American Institute of Mining Engineers to California. The visiting delegates were first entertained at Los Angeles and visited the adjacent oilfields. At San Francisco several technical sessions were held, which were enlivened by an all-day visit to the dredging operations of the Natomas Consolidated at Folsom and a Sunday spent at the famous Bohemian Grove, where an outdoor luncheon, followed by a concert, was enjoyed. On Monday, October 16, the local members of the Mining and Metallurgical Society of America entertained the visiting members and distinguished guests at dinner at the Fairmont hotel. The dinner was followed by a discussion of the Alaskan land laws, H. Foster Bain being the chief speaker; in the subsequent discussion R. W. Raymond, George Otis Smith, E. W. Parker, W. R. Ingalls, Charles G. Yale, M. L. Requa, W. C. Ralston, R. Kanda, and W. L. Saunders joined. On October 17, members of the Institute and friends to the number of 80 sailed for Japan, where they will be the guests of the Japanese Mine-owners Association, returning to San Francisco on December 7. The meeting was one of the most interesting and successful in recent years.

Smelter Fume.—A novel method of dealing with the sulphur dioxide in smelter fume has been suggested by Stewart W. Young of Stanford University. The copper ores smelted in Shasta county are of such a character that the smelting charge is nearly one-third sulphur. Needless to say, the escaping fume has a high sulphurous content and in the moist climate of the mountain valleys has a corresponding effect on vegetation. The method elsewhere followed of manufacturing sulphuric acid from the escaping gases is scarcely applicable, as none of the smelting plants is of large enough size to manufacture a by-product at a profit, and, in addition, the acid works already in operation near San Francisco are already adequate to supply the present demand. Mr. Young proposes to reduce the SO_2 to S by means of crude oil, using calcium sulphide as the intermediary. The difficulties which are likely to present themselves in the carrying out of this process are obvious; the likelihood that the calcium sulphite, which is to be converted into calcium sulphide by the SO_2 and back to calcium sulphide by heating with crude petroleum, will become inactive after a short period of use, and the danger that the cost of reduction will out-weigh the advantage gained, to

name but two, are likely to prove too high stiles for the new process to get over.

Oil.— M. L. Requa, at the San Francisco meeting of the American Institute of Mining Engineers, strongly urged the governmental control of oil production. He asserts that oil is now being so recklessly produced that no adequate market can be secured for it, much of it is wasted and the rest is sold at a rate which yields only a small return to the producers. The mineral wealth of California is thus squandered and that commonwealth suffers to benefit adjacent districts.

C. W. Hayes has resigned as chief geologist for the United States Geological Survey to take charge of the Mexican oil interests controlled by Lord Cowdray. Mr. Hayes is a geologist and explorer of proved ability and has done notable work as an executive. The position left vacant by his resignation has been offered to Alfred H. Brooks, who has been in charge of the Survey's work in Alaska, but Mr. Brooks so strongly prefers to continue his work in Alaska that he will remain in his present position. [We heartily congratulate Alaska on this decision.—EDITOR].

The Utah Copper Co. now has the Bingham & Garfield railroad in operation, and is shipping 11,000 tons per day over the line. A compromise has been effected with the Rio Grande, which claimed that it had an exclusive contract with the Utah Copper Co. for handling its ore, and the two roads will cooperate, as the Rio Grande is now handling cars for the Bingham & Garfield.

TORONTO.

Porcupine.—After a long period of depression there has latterly been a pronounced revival of activity in several of the Porcupine issues. Hollinger, which leads the market, is selling at over $12. Preston East Dome, one of the cheaper stocks, has been greatly in demand, a very rich find having been reported on the Brydges claim immediately adjoining, now known as the Little Pet. The principal interest, however, centres in the Dome and Dome Extension properties, owing to the large scale on which their plants are being constructed. Both have nearly finished their permanent buildings, which are most substantially built of cement, brick, and steel. Both companies have well-equipped independent power-plants, so that in case of failure of the supply of electric power from the Mattagami river, which will shortly be available, no such stoppage as interfered with the operations at Cobalt this spring need be feared. Drills are being used to test at depth the rich vein found on the surface at the Dome known as the Golden Side-walk and it is currently reported that it has been found at 500 ft. The Dome Extension is also drilling to tap this deposit at depth, and has resumed work on its main shaft. At the West Dome the ridge extending from the Dome property is being tested by core-drilling. Four shafts will shortly be put down. Steady development work on the Rea has resulted in the blocking-out of a large amount of ore. The main shaft is down nearly 300 ft. and is connected with shaft No. 2 at

PROSPECTING AT SWASTIKA.

the 200-ft. level. The main vein, which has been uncovered for 400 ft., is from 12 to 20 ft. wide. Harold Kingsmill, late manager, has resigned to go to South America. The Crown Chartered has begun development work on the Davidson claims. The Scottish Cobalt has been transferred to the Scottish Ontario company representing British interests capitalized at $1,000,000. It is planned to install improved machinery and work on a large scale. The Hollinger has completed over 1100 ft. of driving and is putting down a double-compartment shaft to 500 ft. to connect all the underground workings, operations having been delayed considerably by the difficulty in transporting materials. The Dobie has cut the main vein at 55 ft. in the shaft. George E. Farish has been appointed manager in place of Charles E. Watson, who goes to the Plenaurum in the same capacity, the control of the two mines being largely identical. The Pearl Lake, having obtained excellent assays from a deep drill-core, will sink the main shaft to 400 ft. The McIntyre has ordered a 40-stamp mill and is putting down five shafts. Good ore is being mined on the 100-ft. level. The Vipond has ordered a mill of 100 tons capacity. The Eldorado has struck a rich vein in the shaft at 30 ft. Operations on the Success have been suspended.

The Swastika district, on the line of the Temiskaming & North Ontario Railway about 65 miles east of Porcupine, is rapidly coming into prominence. There are now about 3000 people in this area, a large proportion of them being Americans. The principal mine is the Swastika, where a large amount of development has been done. It has installed a 12-drill compressor and machinery sufficient to accomplish 600 ft. per month of underground work. The Homestead is a recent flotation capitalized at $2,000,000 and operating a property of 78 acres on which an adit has been driven into the hillside for 75 ft. The Pike Lake has started sinking on a 40 ft. lode carrying free gold. At the Lucky Cross a shaft is being put down by hand until the compressor, now in course of erection, is ready.

Cobalt.—Little attention is being paid to Cobalt, the market continuing featureless in the absence of important developments. Shipments from the producing mines are well maintained. The Beaver made a good strike last month, when a new vein carrying high-grade ore, 8 in. wide, was cut in driving from the 350 level of No. 5. The main shaft of the Temiskaming is being put down from 600 to 650 ft., where the eighth level will be run, being 75 ft. below the greatest depth previously worked in the district. Another new vein has been opened up at the Trethewey in cross-cutting on the 150 ft. level from shaft No. 2. Though not wide it carries high silver contents. The Kerr Lake, in consequence of unsatisfactory reports as to the ore in reserve, has cut out its extra dividend, reducing the payment for the last quarter of the year to 5%. With this payment the company will have returned to the shareholders a total of $3,720,000, being 124% on its capitalization. Mercury was recently discovered in the ore of the Nipissing, and an investigation is being undertaken by the Bureau of Mines with the object of determining in what mineral combinations this metal is found, and whether it occurs in sufficient quantity to make the discovery of commercial importance.

Later information confirms the report as to the finding of a rich ore deposit on the Brydges claim, otherwise the Little Pet, adjoining the Preston property. It is from 3 to 4 ft. wide and assays high and appears to follow the line of contact between the porphyry and greenstone through the Preston. A mining plant has been ordered for the Brydges. A controlling interest in the Porcupine Imperial has been purchased by Charles D. Taylor, of California. At the Miller-Middleton the vein has been struck by cross-cutting on the 75-ft. level and shows as well as on the surface.

At Cobalt the Beaver is preparing to install a mill for the treatment of low-grade ore with a capacity of 50 tons per day. It will be constructed on the Hardinge principle with two crushers, a pebble-mill and a tube-mill taking the place of stamps. The Drummond is developing a rich though narrow vein recently found on the surface that has been followed underground for some distance. It is paralleled by another vein, which promises well. The annual report of the City of Cobalt shows a production of 292,694 oz. silver from 392 tons, with ore in reserve estimated to contain 181,650 oz. It was decided not to resume dividend payments, production having fallen off owing to the inability of the company to obtain a contract with a concentrating mill for the treatment of the low-grade ore.

R. B. Stewart has prepared a preliminary report for the Ontario Bureau of Mines on West Shining Tree, the new gold district 70 miles north of Sudbury. The region, he says, is mainly level, with few rock exposures. The geology is complex. The discoveries for the most part are located on zones of weathered

schist containing veins and stringers of quartz generally conforming to the strike and dip of the schist. As to their extent little can be said as not much stripping has been done. The quartz widens in places to several feet, but does not carry this width far till it breaks up into stringers or disappears. Mr. Stewart visited 13 properties, on several of which he found free gold. At Gosselins, the pioneer claim, he noted that the stripping had disclosed what was apparently a large body of quartz carrying free gold. Seven samples collected from properties where no gold was visible were assayed at the Provincial assay-office, and six of them were found to assay from 40c to $6 per ton.

it is anticipated that the remaining 25 fathoms of water in the bottom of the mine will be pumped out without difficulty. The upper levels of this famous old copper mine prove to have been 'skinned' by tributers in the previous working, but the management hopes for better things in the bottom levels. Such anticipations usually prove fallacious, and it is unreasonable to expect that the old people, in the days of extensive tributing and scanty development, left much payable ground standing. Companies unwatering old Cornish mines must be prepared with sufficient capital not only to get the water out, but to prosecute vigorous development. Captain Josiah Paull, of South Crofty, recently made an inspection of the mine.

WHEAL AGAR PUMPING-ENGINE.

CAMBORNE.

Wheal Hampton.—This little property, owned by the St. Stephens Syndicate, Ltd., and situated close to the old Tregurtha Downs mine at Marazion, has got into its regular stride, now that the reorganization of the mill has been completed. For the past ten weeks, the quantity of black tin sold at the tin ticketings has been at the rate of five tons per fortnight, and there is every reason to believe that this production can be maintained. Already an interim dividend of 2s. per share has been declared on the preference shares.

Tresavean.—Pumping has now been resumed at this mine and the water is being held below the 260 fm. level. A third stationary pump is being installed, and with this at work,

Basset Mines.—The last two or three monthly reports from this property have been disappointing, for whereas earlier in the year, substantial profits were being made, lately the expenditure has nearly equalled the receipts; indeed for the last four weeks, the balance in favour of the mine was only £14, excluding any allowance for depreciation. An important feature of the Basset monthly progress reports is that an estimate of the receipts and expenditure is furnished, and this useful information is no doubt much appreciated by the shareholders; Basset's lead in this direction might well be followed by the other prominent mines of the county. With this evidence of progress, the fact that the manager continues the absurd practice of reporting discoveries at a monetary

value per fathom is all the more glaring. The tonnage stamped for the past month was 3440, and the sales of black tin, 41 tons, or a recovery of close on 27 lb. per ton, which compares with 38·6 lb., the average produce for 1910. Pascoe's shaft is being sunk in a large lode "worth £25 per cubic fathom"; this is a little above the average produce of the mine.

East Pool & Agar.—A loss of £86 as compared with a profit of £90 for the previous quarter, a reduction in the tonnage milled of over 300 tons owing to shortage of water for dressing operations, the installation of a tube-mill, and the fact that the whole water of the two mines is being handled by the Agar 90-in. Cornish engine, are the chief features of the report just issued for the quarter ended September 23. The following figures are interesting:—

Ore milled	13,418 tons
Value of black tin sold (107 tons)	£12,000
Value of arsenic sold	£150
Value of wolfram sold	£956
Value of black tin per ton ore milled	19s. 6d.
Produce black tin per ton milled	17 9 lb.
Total receipts per ton milled	19s. 10d.
Total expenditure per ton milled	19s. 11d.
Loss per ton milled	1d.
Development footage	214 ft.
Development per ton milled	1 ft. to 63 tons
Employees on surface	250
Employees underground	233

The working cost given above is close on 2d. per ton more than shown in the report, but the difference is accounted for by a contribution by Mr. Basset of £117 towards the sinking of East Pool engine shaft, which has been wrongly deducted. The development footage is still ridiculously small for the output; also the number of employees on the surface is high when compared with the underground force. On the other hand, although no figure is fixed, large sums of money continue to be spent on the renovation of Agar shaft. This work is absolutely essential; but with the produce so low, with no reserve of funds available, and with shareholders unwilling to pay calls, the expenditure thereon necessarily curtails development.

Wheal Peevor.—Recently a company with an authorized capital of £30,000 was formed to acquire and work this group of famous mines near Redruth. The plant now being installed has been removed from Wheal Gorland at St. Day, a property which Edgar Allen & Co., who are largely interested in Peevor, worked for wolfram, but which they abandoned some months ago. The scheme is to work the ground above adit and, if results are satisfactory, to unwater the mine later.

MELBOURNE.

Labour Situation.—The veil has at last been lifted in respect to the ambitions of the Labour Party, which now dominates Federal politics. In Trades Union circles "Preference for Unionists" has long been the cry. An attempt was made some time ago by the Labour Party, when in opposition, to induce the Federal Parliament to enact that this principle should be recognized in the statute law of the Commonwealth, but the legislature would only consent to preference having to be given to unionists "other things being equal." This law has not been amended, but the statement was circulated quite recently that King O'Malley, the Minister for Home Affairs, had issued a circular which stipulated that in public works preference should be given to unionists. Further enquiry revealed the fact that the officers of the Department had issued the circular, but had evidently taken their cue from the tone of the Minister, who assumes all responsibility in connection with their action. The Prime Minister was questioned and he declined to bring pressure on his colleague, who while generally regarded as a wild Yankee has not neglected the main chance during his life in Australia. To this end he has adopted the most extreme labour views. Mr. Fisher's indirect adhesion to Mr. O'Malley's circular at once led the leader of the Opposition, Alfred Deakin, to move a vote of censure on the Government for introducing the preference principle. Mr. Deakin is always heard at his best when he is dealing with questions of this kind, and his point that the Government could not be classed as a private employer but as representing every taxpayer, whether unionist or non-unionist, could not be met. He insisted that the State therefore had to regard each of its servants in the broad light of the taxpayer, and that if one of two people had to be discharged preference should be given to the man of greater ability without regard to whether he was unionist or non-unionist. No real reply was attempted by the labour leaders to this argument, because it was irrefutable. They put up the American axiom that to the victors belongs the spoil. They insisted all through that their policy had been preference to unionists, that they would be forced from their platform if they departed from their election pledges, and that they intended to support the Government in its action.

The scheme they have in view, of course, is to force electors into the unionist fold and so to secure for themselves a majority that will enable them to control the fortunes of the

country. Although they do not admit it, these are the tactics of Boss Tweed and it is an ominous beginning for the Labour Party to have openly nailed to its mast the banner bearing the words "spoils to the victor." Of course unionists are delighted, but there is a sober element in Australia that is stirred to the depths lest there be a possibility of corrupt practices creeping into political life such as have disfigured the course of American legislation. The best thing that can be said is that the farming community is beginning to awaken to this consideration. They wanted the land-tax to break up big estates. They have got it, and they have found, as so many other communities have done, that you cannot limit the effect of taxation to any one class.

Labour Trouble at Mount Lyell.—The restlessness of every class of worker ever since the Labour Party has been in power has been intense, and the latest demonstration has occurred at Mount Lyell, where the men threw down their tools because the general manager, Robert Sticht, found it necessary to discharge a worker named White who had entered the mine, without permission, in his off-time to find out whether two contractors were disobeying the Union rule that all members of the Union should work exactly 8 hours. The entrance to the mine at such a time was unpardonable, unless the control of the whole of the property was to be handed over to the unionists. When the man had been discharged, the Union claimed that he should be reinstated, as they said the punishment was greater than the offence justified. They claimed that the management, by permitting contractors to work their own time, and throwing upon the Union the responsibility of disciplining them to the eight-hour system, was undermining that system, although the company has recognized the principle for years past. Upon the management declining to yield, the Union gave notice that, if before a certain hour it did not reinstate White, the men would be withdrawn. This was done, and at the same time the step was taken to notify the directors that a 50% increase in wages was asked for, that smoking while on shift was wanted, that the fumes from the explosives used were objected to, and that the right was claimed that Union officials should be recognized as such on the mines. All sorts of high officials have sought to arbitrate between the workmen and the company, but the Board throughout declined to permit the question of the reinstating of White to be discussed. They said they would give consideration to the question of the increase in wages and the other demands of the men, provided proper time be given for such consideration. On the day of writing the two sides were absolutely at issue.

Mr. Sticht declares that he would sooner resign his position than consent to White being reinstated, and the Board to a man support him. If the engine-drivers should throw in their lot with the strikers then there will be a risk of the mines being flooded and the whole of the superphosphate business of the company being

brought to a standstill. This would be a very serious matter just now, because this is the time of the year when the company is busily engaged in the manufacture of artificial manures.

Great Fitzroy.—The management of this mine, in Queensland, has been devoting a good deal of time to the readjustment of the mill. The plant is now running about half-time, and securing an extraction of 71½% copper and

57½% of the gold in the ore. Extraction has been affected by an accident in the grinding section, prior to which a test run gave a recovery of 81% copper and 65% gold. If such an extraction could be maintained, the company would be able to show some little profit, without any improvement in the price of copper. Smelting is not altogether satisfactory, as the ore is exceedingly silicious, hence, with the fall in the grade of ore, the smelter work shows a loss of £1200 for September. Better returns are expected for October, and in November the hope is that a profit will be earned.

Mount Elliot.—Another Queensland company that has resumed smelting is the Mount Elliott where operations were interrupted by a creep in the mine. The plant has been shutdown since June and the furnace was put into commission again in September. Meanwhile the underground workings have been made secure and the usual output of ore can now be maintained. The company has taken an option on the Limestone claim near Cloncurry, which is one of the most promising properties in the district. The price at which the claim is under offer is trifling and the expectation today is that the company has obtained a bargain. Of course, this can only be proved by further exploration. The Mount Elliott company is handling the Hampden company's matte under advantageous terms to both parties. At the latter mine the No. 2 plant is being pushed ahead as fast as is possible, while no time is being lost by the Government in laying the railway line that will connect the Duchess mine with the Hampden. Developments underground at the former mine show the presence of high-grade ore, and the company's new Trekelana lease is opening-up well. The great question throughout the district is whether a central smelting establishment shall be provided. Therefore it has been suggested that the Hampden and Mount Elliott companies should fuse, but a difficulty now in the way seems to be the apportionment of interests. The first section of the survey for a railway that will practically link Cloncurry with the big mineral district to the northwest, and then reach the Gulf of Carpentaria at a point where a deep harbour could be built, is now completed. Such a railway would be of immense importance to the vast mineral field that lies around Cloncurry.

New Zealand Coal.—The balance-sheet of the State coal mine of New Zealand is not an impressive document. The results for the year indicate that a profit of £1051 was made, against £4909 for the preceding year. Seeing that 207,000 tons of coal was sold and that the Railway Department was charged a higher price than the private consumer, such a return does not satisfy anyone. The largest consumers were private buyers and the shipping companies, who took 88,500 tons, as against 62,900 tons sent to the various depôts to be retailed to the public. The output of the mine was just about the same as during the preceding twelve months, but the working expenses were heavier, and in addition a large quantity of slack was produced. The Point Elizabeth mine was responsible for an output of 209,253 tons and the Seddonville mine for 51,550 tons. The gross output of the Point Elizabeth mine to date is 1,322,000 tons. There is a debenture debt of £130,000 to be wiped out in connection with the two enterprises, and a good deal more profit will have to be made if that liability is to be rapidly reduced.

Tasmania Gold.—The news that the Tasmania gold mine has had to levy a call after fighting against odds for so many years has occasioned great regret in mining circles. The fact of the matter is that the shoot of gold has not maintained its richness nor its size. The water trouble also is always serious and entails high costs. The reconstruction of the company was carried through easily because a shoot of good-grade ore was met. Developments since then have not been so encouraging, and with costs heavy the only chance ahead was to improve the finance by making calls.

Broken Hill.—This district is in a prosperous condition. The high prices of both lead and spelter have helped both the mining and the process companies. Of the latter the most prosperous is the Amalgamated Zinc, and the news is just out that a shilling dividend for the quarter has been declared. The hope of the shareholders was that as the company has £70,000 or £80,000 cash in hand, a higher dividend would have been forthcoming, but the policy of the directors is to build up the reserve to £150,000. They would then be able to face any fluctuations in the metal market with equanimity and keep dividends at one level unless a real slump should take place. In all probability a larger dividend will be available for the December term. The Broken Hill Proprietary company, aided by the price of zinc, has within the past three months replaced £75,000 to reserve. Its cash reserve now stands at over £95,000. Of the old reserve fund of £260,000, no less than £239,800 has been used in the company's

business, principally in connection with its custom works. There had in addition been an expenditure of £86,000 on the spelter plant, which had been paid for out of the reserve fund. By replacing £75,000 to reserve that fund has almost recouped its outlay on the plant, with the result that it now stands at pretty well its original figure of £260,000, leaving the spelter plant really showing in the books at only about £11,000. The company may not bring out the figures in this way, but that is the position. The other interesting feature in connection with Broken Hill mining is the developments at the British mine. Here boring from the No. 3 level of Thompson's shaft proved the upward continuation of the shoot of ore that had been drilled at No. 5, 6, and 7 levels, and is also being opened-up by a big cross-cut for 110 ft. in length at the No. 9 level with the face in the latter workings still in high-grade sulphides. The diamond-drill is now at work on the No. 2 level. In addition, the company has opened a cross-cut off No. 1 level which has run into carbonate ore. The market here has responded to these developments and the shares of the company are being more freely bought than all the rest of the Barrier mines put together. There are rumours that an attempt is to be made to reconstruct the company in London under 'distinguished' auspices. Any project of this kind will receive the opposition of the shareholders at Adelaide.

NEW YORK.

Steel Corporation affairs occupy the centre of the stage just now. The suit aiming at its dissolution, filed by the Government on October 26, was not wholly unexpected, but it was commonly supposed that action would be postponed until the courts had had an opportunity to dispose of certain other suits of similar nature now pending. The suit was filed, furthermore, only a few hours after the directors of the corporation had formally decided to relinquish certain leases that it held on iron-ore lands in Minnesota, and to reduce the freight-charges on its railroad in that district, both of which acts had been expected to delay prosecution, inasmuch as both the leases and the exorbitant freight-rates had been the subject of adverse criticism. In now familiar terms, the Government accuses 18 individuals, among whom are Morgan, Rockefeller, Carnegie, Gary, Frick, and Gayley, 17 corporations engaged in the manufacture of iron and steel products, and a long list of iron-mining companies, of unlawful acts tending toward combinations and conspiracies in restraint of trade and commerce, and brought about by illegal arrangements to monopolize trade and fix prices, and to destroy competition. In conclusion, the Government appeals to the Court to enjoin any further continuance of the present plan by which the subsidiary concerns pay their dividends into the general funds of the Steel Corporation; in short, to

MORENCI, ARIZONA, SHOWING ARIZONA COPPER CO.'S CONCENTRATOR AND SMELTER

dissolve the Trust into its component elements.

The complaint goes deeply into the history of the Trust, tracing its growth from the organization of the Federal Steel Co., in 1898, up to the absorption of the Tennessee Coal & Iron Co., in 1907. In describing each event the complaint take occasion to point out to what extent the capitalization was expanded, and how much of the new capital stock was pocketed by the promoters of the consolidation. It is estimated that not less than $130,000,000 (par value) was sequestrated at one time or another by the underwriting syndicates. Again, in referring to the absorption of the Carnegie Steel Co., the complaint states that $492,006,000 was paid for that property, for which Mr. Morgan had, not long before, refused to pay $160,000,000. Finally, in connection with the absorption of the Tennessee Coal & Iron Co., the complaint alleges that Messrs. Frick and Gary brought improper influence to bear on President Roosevelt, in fact, were guilty of misrepresentation when appealing to him for permission to commit what was plainly a breach of the law.

The reply, unofficially tendered as yet, is a general denial of any actual or intended wrongdoing, asserting that the corporation had never sought nor exercised any monopoly of trade, nor any improper influence in the regulation of prices. In this connection, a bit of inside history, which I have learned from one well qualified to know the facts, is of interest. When E. C. Converse, in whose mind originated the idea of the steel trust, brought to Mr. Morgan a list of the concerns that were contemplated for consolidation, together with estimates of their value, Mr. Morgan blue-pencilled the list rather remorselessly, declaring that he would have nothing to do with any combination approaching a monopoly of the steel business, or in other ways coming under the ban of the Sherman law. Some concerns that sought to be absorbed were refused admission. As a result of this stand, the Trust does not now control much more than one-half the total steel output of the country, and, in fact, the proportion is smaller now than at the outset; on this phase of the complaint the Trust seems to have a clear case. On the score of fixing prices, also, and of controlling output, the Trust can likewise present a fairly convincing rejoinder. To sustain this accusation, the Government's complaint refers to the nominally purely social gatherings at the invitation of President Gary, alleging that prices were there regulated and output allotted. This will be hard to prove.

The weak points in the Steel Corporation's defence, it seems to me, are the obvious facts, first that at each absorption of another concern, the amount of stock issued in payment for it was grossly in excess of its real value, even allowing for full capitalization of its earning capacity, and second, that the conditions leading to the merger of the Tennessee Coal & Iron Co. were a transparent fake. In connection with the first point, it was well known at the time it was issued that the common stock of the United States Steel Corporation represented nothing but anticipated earnings and good-will, which were optimistically capitalized at $500,000,000. By setting apart liberal allowances for construction, repairs, sinking-fund, and surplus, however, the corporation has added about $335,000,000 to its assets, by virtue of which the common stock, once practically given away, now has a value approximating, if it does not actually exceed, its market quotation. While this doubtless worked a hardship on those whose purchases have helped to make the assets tangible, it may prove not to have been illegal. As to the Tennessee merger, whether Frick and Gary had only the highest altruistic motives in seeking to allay the stock-market panic of 1907 by taking over the control of that valuable and active competitor, or whether they did or did not mislead President Roosevelt, the deed seems to have been a flagrant violation of the law, and furthermore the Constitution gives no discretion to the President to ignore, much less sanction, a proposal to violate the law.

The outcome of the suit, in the opinion of those well qualified to know, will probably be the evolution of some arrangement whereby further illegal consolidations will be rendered impossible, without proceeding to the extremity of demanding absolute disintegration. The directors of the Corporation are too powerful and they have too much at stake to submit tamely to the demands of the Attorney-General. The suit will be strenuously contested, but the Government has announced its intention to hasten procedure as much as possible in order to disarm criticism that the suit was brought just at this time for political effect on the forthcoming presidential election.

The magnitude of the Steel Corporation almost passes comprehension. Its bonded and share capitalization totals $1,465,000,000, of which the stock, amounting to $868,580,000, is divided among 150,000 or more shareholders, by far the largest list on the books of any

American concern. Its annual gross receipts exceed by several million dollars the total income of the United States Government from all sources. In the first nine years of its existence its total net earnings, averaging 25% of its gross income, have reached the enormous aggregate of 1250 million dollars, out of which it has distributed dividends of $394,000,000, paid a bond interest of $208,790,000, besides putting $210,000,000 of earnings back into improvements and enlargements, and accumulating a net surplus, at the end of 1910, amounting to $164,000,000. In point of output, the Corporation produces annually more steel than all Germany, more than twice as much as Great Britain, and three times as much as France.

The Stock Market was but slightly affected by the announcement of the Steel Trust suit. Steel common dropped quickly from 55 to 50, the lowest it has been since 1909, while the preferred declined from 105 to 103, also the lowest it has been for a long time. On the day after the announcement, over 700,000 shares of the common stock changed hands on the Stock Exchange, amounting to nearly one-half the day's transactions in all securities on that floor. Mining stock, however, showed not the least sympathy with Steel; in the day's excitement, of course, they sold off fractionally, but quickly recovered and then resumed their slow upward course. As compared with a month ago, Amalgamated has risen 5 points; A. S. & R. common, 3; Chino, $3\frac{1}{8}$; Tennessee Copper, $3\frac{1}{2}$; and Utah Copper, $4\frac{1}{2}$ points.

The Tariff, which without exaggeration can be named the mother of trusts, still rankles in the minds of the public, in spite of the President's tour of explanation and apology. No high order of intelligence is needed to perceive the connection between a Government bounty of $8 per ton on steel rails, for example, and the enormous profits of the Steel Trust. The Tariff Commission, to which the President pins his whole faith, promises to be ready with its report on wool by the time the next Congress meets, in December, and other schedules will then come in for examination. It is safe to say that the next time tariff revision occurs, it will be in a genuinely downward direction.

The Copper market continues to improve. Domestic stocks have been reduced by reason of decreased output during the past month, and by encouragingly large sales both for home consumption and for export. Shipments to Germany continue heavy. It is hard to find any sound reason to expect a lower price for copper in the near future, in spite of the additions to producing capacity that are occurring almost daily. Braden and Chino have recently entered the producers' list, and both should be working at nearly full capacity within a few months. The market is in such condition now that mere price has but little influence on consumption; in fact, the lower the price goes the more reluctance the consumers display in placing their orders in advance, wherefore the hand-to-mouth policy is now firmly established. The market has reduced itself to a question for the producers to settle by themselves, on the basis of cost.

The Copper Range Wharf, Michigan.

Enthusiastic welcome awaits the newly formed Anglo-French Financial Company of Canada, which Frederick W. Baker and Norton Griffiths have organized for investment in American mines and railways. That men associated with the Venture Corporation are disposed to increase their holdings in this country and Canada is taken as indicating that their experience here has been satisfactory. [Neither of these gentlemen is now associated with the London Venture Corporation, the successor of the Venture Corporation; Mr. Baker is with the Hirsch Syndicate.—EDITOR]. Whether they will find a new Camp Bird at Porcupine is uncertain, but at least the advent of another experienced and wealthy group of investors will be welcome. In Canada there has been some criticism of Bewick, Moreing & Co. in connection with the Hollinger. The truth seems to be that when it was announced that their firm had gone into Hollinger, speculators put the shares up to such a figure that Bewick, Moreing & Co. were able to sell out and make a profit of about the amount needed for exploration of their other properties. 'Taking profits' naturally appears wrong to the people from whom they are taken. [More money is made by selling than by buying mines, because most mines, especially the rich ones, are sooner or later over-valued by the speculative public.—EDITOR].

STATISTICS

Stocks of Copper in England and the Continent.
Reported by Henry R. Merton & Co.

	Aug. 31. Tons	Sept. 30 Tons	Oct. 31 Tons
In England	52,661	52,111	48,357
In France	5,728	5,654	5,704
Afloat from Chile	1,975	2,375	2,075
Afloat from Australia	6,550	7,200	5,900
Total	66,914	67,340	61,836
In Rotterdam	7,650	7,250	6,900
In Hamburg (estimated)	10,800	11,100	10,200

American Copper Producers' Association.
In Tons of 2,240 lb.

	Production.	Deliveries: Domestic	Deliveries: Foreign	Deliveries: Total	Stocks at end of month
January 1911	51,650	18,785	23,753	42,538	63,591
February	49,050	22,553	20,139	42,692	69,929
March	58,273	29,500	26,375	55,875	72,325
April	52,716	23,396	27,736	51,132	73,909
May	56,679	28,814	27,669	56,483	74,105
June	55,605	27,525	31,902	59,427	70,283
July	50,075	25,438	33,429	58,867	61,491
August	56,024	26,757	31,185	57,942	59,573
September	51,602	25,587	22,689	48,276	62,899
October	52,792	28,602	26,832	55,425	60,267

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Totals, 1910	7,228,588	305,532	7,534,120	32,002,912
January 1911	625,862	25,201	651,027	2,765,386
February	585,683	24,965	610,828	2,594,634
March	649,247	26,818	676,065	2,871,740
April	638,421	29,293	667,714	2,836,267
May	658,196	27,755	685,951	2,913,734
June	657,023	27,544	684,567	2,913,734
July	679,881	29,377	709,258	3,012,738
August	682,405	31,002	713,407	3,030,360
September	669,773	30,852	700,625	2,976,065
October	677,923	30,721	708,644	3,010,130

Cost and Profit on the Rand.

Month.	Tons	Yield per ton	Costs per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
January 1911	1,865,232	26 6	17 11	10 1	930,059
February	1,712,198	28 0	18 3	10 3	874,612
March	1,960,678	28 6	17 11	9 9	949,415
April	1,926,583	27 7	17 6	10 1	971,858
May	2,002,926	27 7	17 10	9 7	956,823
June	1,986,559	27 6	17 11	9 8	960,381
July	2,095,220	27 2	17 10	9 4	969,687
August	2,107,809	26 8	17 9	8 11	967,457
September	2,037,329	27 4	18 1	9 4	952,665
Totals and averages for 1909	20,543,759	28 11	17 1	11 6	11,794,376
Ditto 1910	21,432,541	28 6	17 7	10 6	11,216,105

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31	183,268	8,357	9,991	201,616
February 28	189,434	8,513	9,814	207,761
March 31	193,457	8,493	10,061	212,011
April 30	194,328	8,511	10,272	213,111
May 31	190,392	8,379	10,425	209,196
June 30	186,940	8,212	10,597	205,749
July 31	181,582	8,122	11,054	200,758
August 31	179,810	8,182	11,292	199,284
September 30	179,619	8,045	11,475	199,139
October 31	179,194	8,078	11,319	198,591

Gold Output of India.

Year 1909	Year 1910	Oct. 1911	1911 to date
£2,083,901	£2,104,858	£181,858	£1,595,651

Production of Gold in Rhodesia.

Month.	1908	1909	1910	1911
	£	£	£	£
January	199,388	204,666	227,511	207,903
February	191,635	192,497	203,888	203,055
March	200,615	202,157	228,385	231,947
April	212,935	222,700	228,213	221,296
May	223,867	225,032	224,888	211,413
June	224,920	217,600	214,709	215,347
July	228,151	225,234	195,233	237,517
August	230,792	228,296	191,423	243,712
September	204,262	213,249	178,950	225,777
October	205,466	222,653	234,928	—
November	196,668	236,307	240,573	—
December	217,316	233,397	199,500	—
Totals	2,526,007	2,623,788	2,568,201	—

Production of Gold in West Africa.

Month.	1909 Oz.	1909 Value	1910 Oz.	1910 Value	1911 Oz.	1911 Value
		£		£		£
January	22,817	91,112	17,357	70,699	15,903	66,107
February	21,403	86,210	16,976	68,469	15,179	63,081
March	23,186	93,556	17,627	71,954	16,387	67,673
April	21,491	88,071	16,363	67,069	17,237	70,880
May	25,104	100,056	16,590	68,355	24,427	96,409
June	17,340	70,561	17,194	70,988	22,555	92,174
July	17,331	70,523	15,564	58,551	22,510	91,955
August	17,766	71,614	13,921	57,713	25,385	103,753
September	18,125	72,963	11,497	47,746	26,717	109,039
October	15,957	65,813	13,341	55,046	—	—
November	17,882	73,824	14,021	57,658	—	—
December	17,570	71,332	15,042	61,737	—	—
	235,972	955,635	185,493	755,985	—	—

Production of Gold in Western Australia.

Month.	Export oz.	Mint oz.	Total oz.	Total value
				£
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
January 1911	17,463	102,035	119,498	507,592
February	22,047	84,991	107,038	454,666
March	12,296	93,267	105,563	448,426
April	20,455	91,791	112,246	476,787
May	22,076	88,952	111,028	471,615
June	10,523	106,464	116,987	497,188
July	15,334	97,387	112,721	478,805
August	11,521	102,477	113,993	484,168
September	5,011	114,615	119,626	508,135
October	10,664	106,733	117,397	498,668

Other Australasian Gold Production.

	1909	1910	October 1911	1911 to date
	£	£	£	£
Queensland	1,916,468	1,840,337	146,975*	1,208,160*
New South Wales	869,546	803,727	93,935	648,369
New Zealand	2,006,910	1,896,322	152,964	1,535,615
Victoria	2,897,340	2,422,700	179,985	1,770,107

* September figures only.

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
September 4, 1911	220	£25,262	£114 16 8
September 18, ,,	249¾	£27,170	£108 15 0
October 2, ,,	224¾	£25,221	£112 4 4
October 16, ,,	251	£28,342	£112 19 1
October 30, ,,	235½	£27,176	£115 8 0

Exports of Tin and Ore from Straits and Bolivia.
Reported by A. Strauss & Co.

	Sept. 1911 tons	Oct. 1911 tons	1911 to date tons
Metal from Straits to Europe and America	5148	4,385	44,325
Metallic Content from Bolivia to Europe	2034	1,947	19,294

METAL MARKETS

COPPER.

Average prices of cash standard copper:

Oct. 1911.	Sept. 1911.	Oct. 1910.
£55. 5s. 3d.	£55. 7s. 1d.	£56. 16s. 2d.

September opened with all the producing agencies again in competition, the Amalgamated interests having reduced their price from £58. 5s., for which they had so long held, to £57. In Europe buyers, held back by political uncertainties, were unresponsive, but American consumers, who had long abstained from purchasing, relieved producers of some accumulated stocks. Subsequently the publication of the American figures was followed by depression on the metal exchange and a decline of 10s. in standard sorts. The increase in stocks combined with the heavy decline in exports formed the basis of comment. The decreased output appears to be due to the closing of some smaller producers, the first indication of involuntary curtailment brought about by the continuance of low prices. Producers again made slight concessions and then was seen the effect of the small September shipments and the depletion of consumers' stocks. Helped by good European statistics and more cheery reports from stock exchange circles, the pent-up buying power rapidly developed into a formidable movement which forced American prices up again to 12½ c. and large orders were placed in the United States and Europe for October, November, and December. Standard copper rose 20s., but the price has since given way before the announcement of the prosecution of the Steel Corporation. The decline cannot last, as the enormous consumption requires a constant replenishing of stocks, and if the American situation makes further progress, a rapid rise in prices is probable. Italy is buying largely for sulphate.

TIN.

Average prices of cash Straits tin:

Oct. 1911.	Sept. 1911.	Oct. 1910.
£187. 2s. 9d.	£180. 16s. 11d.	£164. 4s. 9d.

By aggressive manipulation the bull party early in the month raised prices from £176. 10s. to £183. 15s., at the same time lending October tin to January and thereby transforming a backwardation of £2. 10s. into a contango of 5s. By these means they succeeded in carrying their position without paying out heavy differences. Assisted by heavy deliveries of Banka and small shipments from the East they gradually forced prices up to £191. 10s., but their purchases have had an unnatural appearance and create distrust. The month closed with prices down to £187. Consumption has fallen off somewhat. The Welsh tinplate industry is not so brisk and the unsettled conditions and high price of tin is detrimental to healthy development. In America over-production has led to heavy reductions of price in the home trade, and has forced the mills to sell for export in competition with Welsh makers. Dealings on the new 'standard contract' commenced on November 1.

LEAD.

Prices of soft foreign lead:

Oct. 1911.	Sept. 1911.	Oct. 1910.
£15. 6s. 1d.	£14. 15s. 1d.	£13. 2s. 0d.

The tendency is one of continued strength, and the shortness of supplies, already acute, does not mend with time; indeed refineries are overwhelmed with orders and are, especially in America, heavily in arrear. The London market has for some time been largely dependent on Australia, but the announcement of a strike of wharf labourers there threatens to cut off these supplies. Consumption is estimated as being at least 20% in excess of that for last year.

SPELTER.

Average prices of spelter:

Oct. 1911.	Sept. 1911.	Oct. 1910.
£27. 4s. 10d.	£27. 12s. 7d.	£23. 16s. 7d.

High prices have had their inevitable result in curtailing demand and, as we foretold in the September issue, prices have turned. Following a cut in the price of sheets the Syndicate has reduced prices 20s. "with a view to stimulate demand," but buyers are apathetic.

OTHER METALS AND MINERALS.

Prices quoted on November 7:

SILVER.—25¼d. per oz.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£53 per ton.

NICKEL.—£170 per ton.

COBALT.—9s. 9d. per lb.

ANTIMONY.—£28 per ton.

QUICKSILVER.—£8. 10s. per flask.

MANGANESE ORE.—8d. to 9½d. per unit (1%).

IRON ORE.—Cumberland hematite 19s. 6d. per ton at mine. Spanish 20s. delivered.

PIG IRON.—Cleveland 46s. 9d. per ton. Hematite 61s. per ton.

WOLFRAM ORE—30s. per unit (1%).

PERSONAL

A. R. ANDREW sailed on October 27 for New Zealand.

PHILIP ARGALL, general manager of Stratton's Independence, is here.

WILLIAM BACH left London on October 21 to investigate the placer deposits of Cuba.

HOWLAND BANCROFT, on his return from South America, has gone to Mexico.

R. T. BAYLISS left London on November 1 for Mexico. On his return he will proceed to Rhodesia.

FRANK K. BORROW proceeded to the Fontino & Bolivia mines in Colombia on November 8.

E. H. BRANDT left London on October 25 for Monterey, Mexico.

R. W. BROCK, Director of the Canadian Geological Survey, has been ill with fever; he is now in hospital at Vancouver.

R. GILMAN BROWN is at Kyshtim.

GEORGE B. BUTTERWORTH has returned from Northern China.

E. W. BYRDE is now with the Naraguta (Nigeria) Tin Mines, in Nigeria.

FREDERICK T. BYRDE has returned from the Gold Coast.

GELASIO CAETANI is in Colorado.

GEORGE P. CHAPLIN has returned to London from British Columbia, where he has been on behalf of Bruce Marriott & Co.

J. H. COLLINS delivered his presidential address to the Royal Cornwall Geological Society on October 31.

JAMES DOUGLAS will give a lecture on the Copper Queen mine before the Institution of Mining & Metallurgy on November 23.

RALPH ELLIS has gone to Buenos Aires.

ROWLAND FEILDING now has his office at 18 St. Swithin's Lane.

W. B. FISHER has moved from New York to Butte, Montana.

A. J. FRASER has returned from England to Rhodesia.

GEORGE H. FURNER has resumed his duties as manager of the Zaaiplaats tin mine in the Northern Transvaal after six months holiday in England.

PHILIP GRIMLEY has left London for Northern Nigeria.

CLAUDE V. HAINES left London in October for Portuguese East Africa.

C. W. HAYES has resigned from the U.S. Geological Survey to be advisor for S. Pearson & Son in Mexico.

FREDERICK HELLMANN sailed for New York on November 3.

H. W. HILL has returned from the Belgian Congo.

WALTER T. HOLBERTON left on October 27 for Chile, to return in February.

HOOPER, SPEAK & FEILDING is succeeded by Hooper, Speak & Co., with offices at No. 3 London Wall Buildings.

H. H. JOHNSON, of Johnson & Hoffmann, has returned from Porcupine.

HOWARD JOHNSON has returned from Northern Nigeria.

S. RAMPLEN JONES was married to Miss Lucie E. Kruysboom at Colombo on August 1.

F. F. KETT has gone to Nora, Sweden, as general manager for the Swedish Iron Mines & Furnaces, Ltd.

ERNST LICHTENBERG, on his return from Austria, has been ill, but is now convalescent.

W. J. LORING and J. MALCOLM MACLAREN have been inspecting mines in California.

E. D. MCDERMOTT has returned from Kyshtim.

DIGHTON MICHAUX after being for a year in Katanga has returned to Rhodesia.

WILLIAM C. MOUNTAIN has opened an office as consulting engineer at Newcastle-on-Tyne, devoting his attention specially to the application of electricity to mines.

JOHN C. PICKERING sailed for Cape Town on his way to Rhodesia on October 21.

H. A. PIPER has returned from Rhodesia.

C. W. PURINGTON returned from Eastern Siberia on November 10.

H. M. RIDGE has returned from British Columbia.

O. J. STEINHART has returned from Swedish Lapland.

S. J. TRUSCOTT has moved to 27 Austin Friars, London, E.C.

E. J. VALLENTINE, manager of the Rahman tin mine, in the Malay States, is due in London on November 15.

D'ARCY WEATHERBE is now at St. Petersburg but will be in London in December.

GEORGE E. WEBBER sailed for New York on his way to California on November 4.

R. HANSFORD WORTH is consulting engineer to the China Clay Corporation in connection with the development of their property in South Devon.

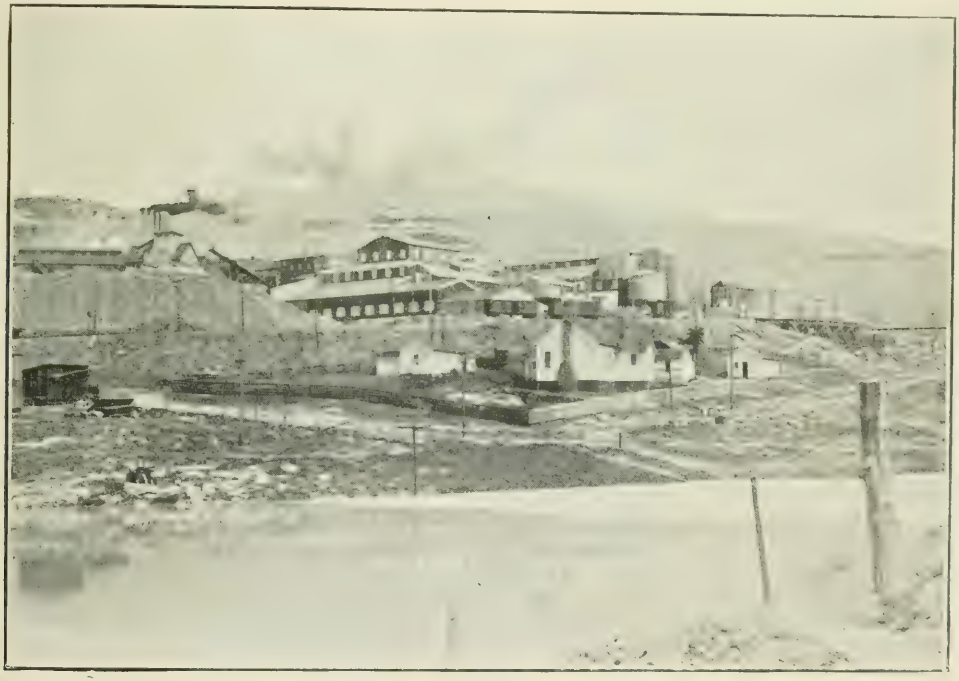
LEWIS T. WRIGHT, recently manager for the Mountain Copper Co., is in London.

Readers appreciating this magazine may give their friends the opportunity of seeing a copy. We will send a specimen copy to any address on receipt of a written application.

MILLING METHODS AT STRATTON'S INDEPENDENCE

By PHILIP ARGALL.

INTRODUCTORY.—In mining and shipping some $20,000,000 worth of gold ore, from the Stratton's Independence mine, something like one million tons of refuse was sorted out and deposited on the dumps. This material was generally assumed to average about $4 per ton, but as was to be expected, the content is quite variable; some of it has reached $5, much of it has not exceeded half that value, while the average will probably not exceed $3·25 per ton.



THE STRATTON'S INDEPENDENCE MILL.

The directors of Stratton's Independence, Ltd., as early as 1903 had experiments made looking to the beneficiation of this ore; an experimental mill was later erected, the ore was treated by various methods, and the dumps sampled.

In November 1906 I was engaged to examine and report on the treatment of this low-grade sulpho-telluride ore, and naturally looked into the use of the various processes, but soon found that no chemical then available would assure satisfactory treatment; consequently, I went back to my first experiments on Cripple Creek ores made in the autumn of 1893, and in the following spring. In these tests concentration was the dominant feature. These early experiments in part formed the basis for my review of cyanidation published in the *Engineering Magazine*, New York, in September 1894, from which it is perhaps permissible to quote:

> "In other cases concentration is advisable. For example: An ore may contain 15% of pyrite, which may require special treatment in the way of a stronger solution, or long exposure to solution—say, 80 hours—in order to obtain a good extraction; while the remaining 85% of the ore may have its gold dissolved in 24 hours. Here, then, separating the heavier from the lighter particles, and subjecting each to separate treatment, will result in a gain of time in lixiviating, saving of chemicals, and increased capacity of the works. The same line of argument holds good if the concentrate cannot be successfully treated by cyanide, as in this case a deleterious material is removed from contact with the cyanide solution, to be handled by such other methods as the particular circumstances will indicate. The cyanide process, then, can be applied

to ores direct, or as a combination process with amalgamation or concentration, or both, as may be found most convenient and profitable."

The concentration method was adopted and my original experiments brought to the fore, after a lapse of 13 years. In the interval, mechanical progress in crushing, in concentrating and in cyaniding machinery, had been marked; but not much advance had been made in the substitution of cyanide solution for water in the entire milling process—an advantage I had seen and tried in the early 'eighties, and still favoured. Experiments on these lines were therefore in order; and on their completion on a laboratory scale I reported to the directors of Stratton's Independence, Ltd., that a mill of 10,000 tons per month could treat the ore for $1·52 per ton, including 10c. per ton for mining; giving an extraction of about 70% of the contained value, then estimated between $3·60 and $3·80 per ton.

A mill with a capacity of 5000 tons per month was planned, and duly erected, tested completely, and later enlarged to its present capacity of 10,000 tons per month.

THE PROCESS is as follows: Coarse crushing in Gates gyratory breakers, medium crushing in 36 in. rolls, fine crushing in Chilean mills. Cyanide solution is added in the Chileans, and thenceforward the process is crushing and concentrating in cyanide solution in a closed circuit. The pulp from the Chilean mills is separated into sand and slime in Ovoca classifiers, the former is treated on 20 Card tables, the latter on 12 No. 3 Deister slime-tables, and 4 suspended vanners. A first and second-class concentrate is produced, the latter being re-treated on Card and Deister tables, producing more first-grade and a middling product that is returned to a tube-mill and, after grinding, joins the pulp issuing from the Chilean mills and circulates in the main circuit of the mill, finding its position in sand and slime.

For details consult flow-sheet and the following legend:

1. Double-track inclined plane.
2. No. 7½ Gates gyratory breaker.
3. Picking-belt 3 ft. wide.
4. No. 5 Gates breaker.
5. 18 in. conveyor-belt.
6. 16 by 36 in. rolls.
7. Stock-bins above Chilean mills.
8. Thickening-cones.
9. No. 3 Deister slime-table.
10. Suspended vanners.
11. Vacuum-filters.
12. Precipitators.
13. Tube-mill.

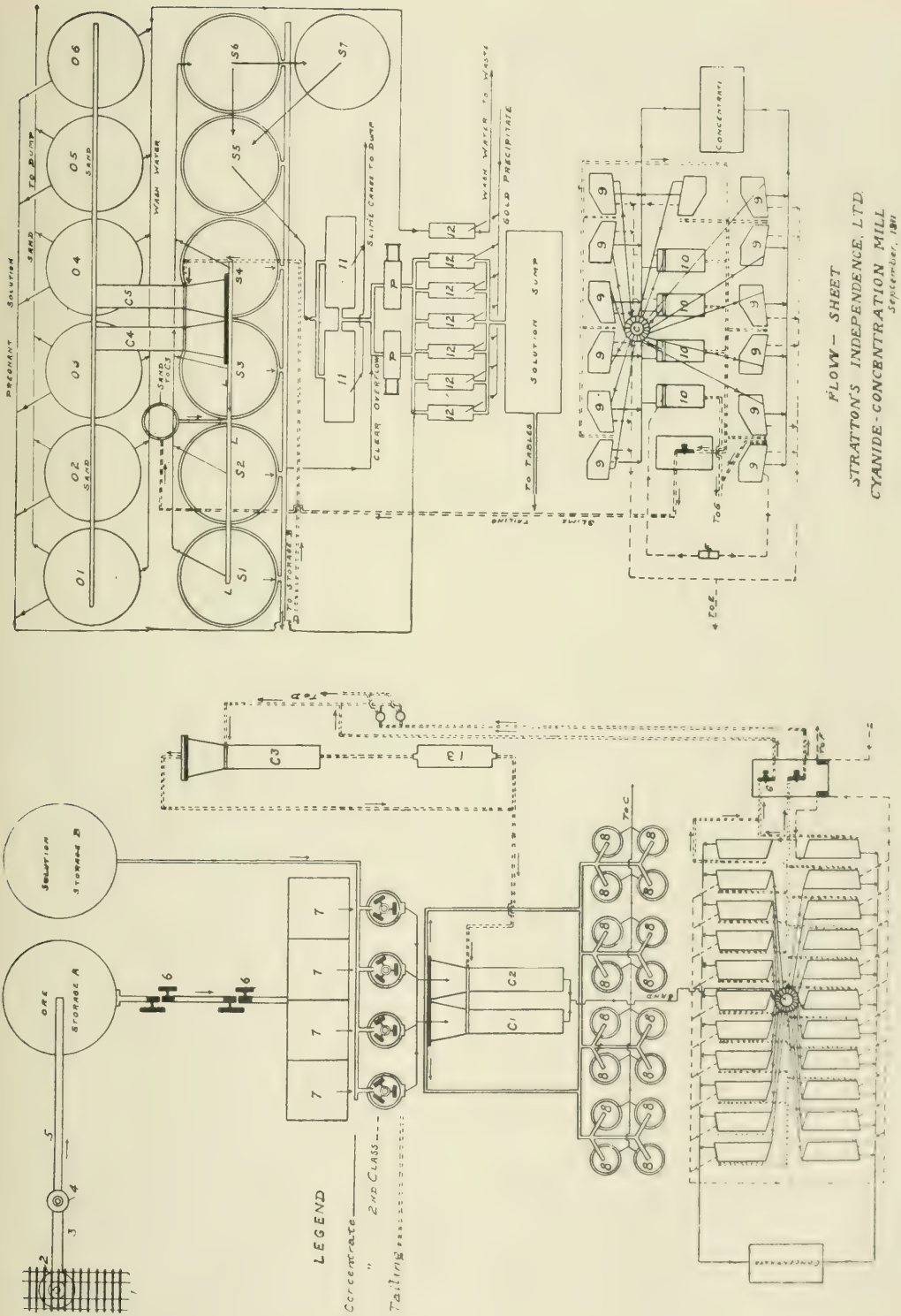
F. Elevator lifting slime 'seconds' for re-concentration.

G. Centrifugal pump lifting tailing from second concentrate for tube-milling.

After concentration, the sand and solution in which it was concentrated are pumped to the cyanide department, the solution being separated and the sand automatically distributed in leaching-vats, *O* 1 to *O* 6. After treatment the sand is sluiced to the tailing-reservoir. The middling from the finishing tables not furnishing sufficient supply for a 5 by 14 ft. tube-mill, two spigots are drawn off from the sand on its way to the cyanide department; this is a partly concentrated product, being the heavier sand that tends to follow the bottom of the slightly inclined pipe.

The slime passes from the Ovoca classifier to 16 thickening-cones; the thickened product is automatically distributed over the Deister and vanner tables in a similar manner to the sand, the second-grade re-concentrated and the middling ground in the tube-mill before again joining the main pulp-stream circulating through the mill. The tailing from the slime-tables is pumped to an overflow-cone in the cyanide department and distributed by launder *L* to four continuous settling-vats, *S* 1 to *S* 4, the product being a thickened slime and a clear-solution overflow. The thickened slime is pumped to *S* 6 for final treatment by cyanide solution, and when required, to *S* 7 for bromo-cyanide treatment. From either of these vats the slime is piped to *S* 5, which supplies the vacuum-filters. From here the slime-cakes pass to the dump and the pregnant solution to the clarifying press (*p*), thence through the precipitators, the barren solution dropping into an underground sump, from which it is circulated for distribution over the concentrating-tables; in other words, the barren solution is used as table-water.

Following the solution, it will be noted from the flow-sheet that the cyanide solution in storage-vat *B* is fed, together with the ore, to the Chilean mills, that 75% of it separated with the slime passes out of the Ovoca classifier to the thickening-cones. The slime-tailing with the solution added to it in the concentration process is pumped to a cone, the overflow passing to launder *L* in the cyanide department, while the clear-solution overflow from vat *S* 1 to *S* 4 returns to the storage-vat *B* for another circuit. Returning now to the sand emerging from the head of the Ovoca classifiers *C* 1 and *C* 2, it is immediately diluted with clear solution direct from storage *B*, which carries the sand to the central distributor,


FLOW-SHEET
STRATTON'S INDEPENDENCE, LTD
CYANIDE-CONCENTRATION MILL
September, 1911
LEGEND
Concentrate
2ND CLASS
Tailing
ORE STORAGE A
SOLUTION STORAGE B
PREGNANT SOLUTION
SAND TO DUMP
WASH WATER
SLIME CAKES TO DUMP
WASH WATER TO WASTE
GOLD PRECIPITATE
SOLUTION SUMP
TO TABLES
CLEAR OVERFLOW
SLIME TAILING
CONCENTRATE
TO C
TO F

which in turn provides a direct supply for each of the 20 Card tables; on these tables barren cyanide solution is used for dressing the ore, passing with the tailing to classifiers *C* 4 and *C* 5. The slime-overflow from these latter enters launder *L* and becomes the main slime-circuit, giving a clear-solution overflow from the vats *S* 1 to *S* 4, which passes direct to storage *B* for another round in the closed circuit of the mill-solution.

This solution is constantly dissolving gold in its circuit through the mill, and as the aim is to *not* allow its gold content to exceed $1 per ton, part of the clear overflow from vats *S* 1—*S* 4 is continuously passed through the clarifying presses (*p*,*p*) and the precipitators (12), finally reaching the sump as barren solution, from which it circulates to the tables, as previously described, joining the main pulp-stream, and thus reducing the gold in the circulating solution. The barren solution is also used for washing the sand charges in the leaching-vats. The bulk of the gold is, however, usually recovered by the special treatment of the thickened slime in *S* 6 and *S* 7, where, after thorough agitation, it passes through *S* 5 to the vacuum-filters, clarifying presses (*p*) and precipitators (12), the barren solution reaching the sump preparatory to making another circuit through the mill. Finally, the pregnant solution from the sand-leaching vats *O* 1 to *O* 6 is piped back to the precipitators, reaching the sump as barren solution, while the final wash-water passes to waste through a special precipitator.

The process, it will be seen, is crushing and concentrating in cyanide solution in a closed circuit, in combination with incomplete precipitation, so that the circulating solution shall never exceed $1 per ton, and shall average about 50 c. per ton. It will be noted that complete precipitation is unnecessary inasmuch as both sand and slime are subjected to further cyanide treatment and water-washes before passing to the dump.

Having now described our milling method and flow-sheet, I shall proceed to describe some of the more important operations in detail.

MINING.—The dump is situated on a hill-side traversed by deep depressions, giving an irregular and uncertain bottom; the ore is usually frozen near the bottom all the year round and in winter requires considerable blasting to prepare it for the shovel. The ore is loaded into 4-ton cars by a power-shovel with dipper of 1 cu. yd. capacity, the machine being operated by one 40 hp. variable speed electric motor, from which the digging, crowding, swinging, and advancing motion are all derived by clutch-gearing controlled by levers operated by one man. By official test the machine easily handled 120 tons per hour. In daily work, however, loading small cars where the dipper has to be spotted each time before dumping, we find 60 tons per hour about the average capacity, though we often reach 75 tons per hour with an expert operator. The ore-cars are hoisted up an incline plane and automatically dumped into a No. 7½ Gates breaker; this ends the mining and delivery at the mill, the cost of which is $0·0891 per ton, divided as follows:

		Per ton
Power	$610·00	$0·0217
Operating labour	1335·04	0·0476
,, supplies	13·60	0·0005
Repairs labour	353·25	0·0125
,, supplies	189·74	0·0068
28,078 tons	$2501·63	0·0891

ORE-BREAKING.—The ore is broken in the 7½ Gates machine to about 4 in. cube, the fine removed by grizzly, the coarse conveyed on a picking-belt to a No. 5 Gates breaker, in which it is reduced to about 1½ in. cube, and conveyed direct to the 300-ton storage-bin, together with the fine removed by the grizzly. The ore cannot be enriched much by sorting, the waste picked out seldom reaching 3%. Of more importance is the steel and wood removed at this point, for these would otherwise seriously interfere with subsequent milling operations. This breaker-plant is operated with the power-shovel and inclined plane about 6 hours per day. The total cost is $0·1633 per ton, of which the sorting or picking amounts to, say, $0·04.

COARSE CRUSHING is accomplished in two sets of 36 by 16 in. rolls, operated in series, having a capacity of 30 tons per hour from 1½ to ¼ inch. The storage-bins in front of the Chilean mills not having capacity for a 16 hours run, the roll-plant is operated during part of two shifts each day, and in order to have more men in the mill on the night shifts, the rolls are operated on the second and night shifts by one man per shift, who also attends to general repairs. Probably one of the best things in this department is the 300-ton self-supporting steel storage-bin (Fig. 1) the simplest and most satisfactory ore-bin I ever used. It is thoroughly automatic, the last pound will come out without the use of crow-bar or shovel. The feeder is of the revolving-table type, subject to two variations: thickness of feed by adjusting the height of the annular sleeve at

bottom of the feed-cone, and width of annulus cut off by the adjustable plough; the feed is also steady and continuous, an important matter in feeding rolls. It will be noted that the opening in the bottom of the ore-bin is large (4 ft. diam.), hence it is ample to prevent any semblance of a choke, and small enough to relieve the feed-cone from excessive pressure. The relation between the 4 ft. opening in the bottom of the main bin, the diameter of feed-cone top and its 1 ft. diam. bottom opening just above the revolving table of the ore-feeder, are important points to observe. The ore stored in this bin is reduced to less than 2 in.

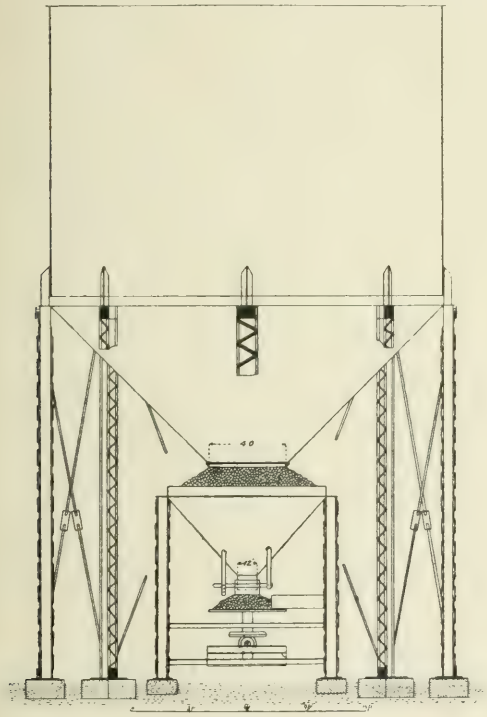


Fig. 1. Steel Storage-Bin.

cube and is fed to the rolls at the rate of 30 tons per hour. The ore is moistened with cyanide solution on the table of the feeder to lay the dust and slack the lime that is added dry at this point by another automatic feeder. The lime is thus well incorporated with the ore in passing through the rolls, and at once begins its work of neutralization in the damp ore, which is then elevated to the storage-bins above each Chilean mill, supposedly reduced to $\frac{1}{4}$ in., but more nearly $\frac{3}{8}$ inch. It should be stated, however, that the ore is mostly phonolite and breaks in thin flakes, that most of the coarse caught on $\frac{1}{2}$ in. aperture screens would be less than $\frac{1}{4}$ in. thick, hence easily crushed by the rollers in the Chilean mills. As originally designed the ore from the second roll was passed through screens with $\frac{1}{4}$ in. aperture; but this was found to be an unnecessary refinement, so the screens were removed and the cost of the screening operation eliminated.

Fine Crushing.—This plant consists of four Akron Chilean mills of 6 ft. diam. (Fig. 3), three of which easily give the capacity required: 10,000 tons per month. The fourth is held in reserve until needed to take the place of either of the others. These mills crush from 100 to 130 tons per day, depending on the feed, the character of the ore and the screens used; with a screen of 0·046 in. aperture 0·054 wire and speed of 33 r.p.m., the capacity is almost 5 tons per hour for an ex-

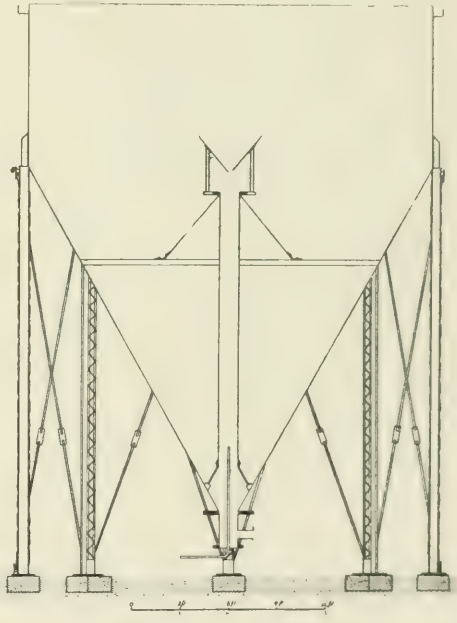


Fig. 2. Pneumatic Agitator.

penditure of 55 hp. The power consumed by Chilean mills depends chiefly on the amount and size of the ore fed to them; secondly, on its crushing qualities. Using relative terms, with a supply of finely comminuted ore the power will be much less than that required for a coarse product, which offers greater resistance to the rollers, even causing them to rise from the die and occasionally ride over coarse tough particles; then again, the resistance is less with a shallow thin feed in the mill, less power is required to operate, and the crushing capacity is also less. For a 6 ft. Akron mill operating on average ore crushed to about $\frac{1}{4}$ in., I would provide a 50 hp. motor guaran-

teed for 20% overload. The following tests are instructive:

The line-shaft driving two 6 ft. Akron mills is operated by a 100 hp. motor; one of these mills was thrown off, and the tests made on the other.

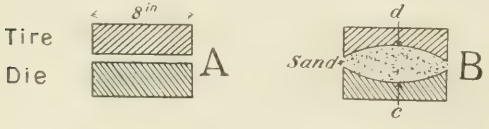
	Input to Motor hp.
Motor and line-shaft	4
Motor line-shaft and Chilean mill, representing the friction load	9
Light feed $\frac{1}{4}$ to $\frac{3}{8}$ in. product to the mill	28
Heavy feed, mill a little crowded but in good running condition	63
The mill was next fed to the limit, crowded, in fact, almost to the stalling point	70
The foregoing results from average of reading every few minutes, for one half-hour. A watt-meter was next placed in the motor-circuit and gave, on a 23-hours test	52
On 317¼ hours test (April 5 to 18, 1911)	53

The mill was in average condition, and during the wattmeter tests was fed and operated under our usual milling conditions, giving an average output of 115 tons per day, of the following composition:

Mesh	Aperture Inch	%
Plus 50	0·0096	21
,, 100	0·0056	12
,, 150	0·0030	5
Minus 150	0·0030	62

The Chilean mill is an admitted slimer, yet it is not by any means as bad as painted. I would call it an efficient crusher that is capable of adjustment, within certain limits, to give a fine, yet granular, product. The comminution of ore in a Chilean mill may be said to be the resultant of two forces, the direct crushing effect, due to the weight and speed of the rollers, the grinding or abrading effect, due to the rollers being constrained to travel in a circular path; hence, they partake of two motions; rotary, around their individual axles, and annular, around the die, concentric to the central axis of the mill.

Let us look into the latter. A circle drawn on the face of the die-ring 4 in. from the side (shown in cross-section at *c*), and a line drawn around the face of the roller tire 4 in. from the



side (similarly shown at *d*), represents the lines of maximum wear on tires and die in a Chilean mill. The corrugations in the 8 in. crushing-faces reach their maximum approximately along these lines.

A section of new steel is shown at A, while B shows the worn steel. Why should the steel wear in this manner? The answer is twofold. First, the coarser ore is dropped from the feed-pipe approximately along the circle *c* of the die, and forms a ridge; the principal reason is, however, the grinding or abrading action occurring there. A roller, in making the circuit of the die, also completes a revolution on the line *d* at right angles to its axis of rotation. It is this annular direction of the rollers, deflecting them from a straight course and pure rolling motion that causes the grinding or abrading effect; the smaller the diameter of the die, the greater is the abrading effect or twist on the ore particles held between the die-ring and the tire of the rollers; on the other hand, the greater the diameter of the die the more nearly the rollers approach a pure rolling motion with lessened abrasion and lowered efficiency as a fine crusher, or slimer, if you will. For this reason the so-called 'slow-speed mills' with large diameter die-rings are not slimers and scarcely come within the fine-crushing class, they approximate more nearly the work of rolls than that of Chilean mills. In these the roller receives its rotary motion through friction with the ore on the die-ring, the line *d* around the centre of the tire-face theoretically should roll upon the fragments while the outer margins of the tire-face slide over them; as the roller advances, constantly bending inward from a straight path, its outer flange crowds the ore in front, inward on the die, its rear outward on the screen, particularly after corrugation is established. In our mills we have abandoned the use of scrapers depending solely on the wheel-splash for the screening effect.

The capacity of the Chilean mill increases slightly as the steel wears, as does also the power; but these are balanced somewhat by the lessening weight of the rollers due to tire wear; with both die-ring and tires corrugated, as in *B*, the Chilean mill usually gives its maximum efficiency as a fine grinder inasmuch as both the twisting (abrading) action and the weight of the roller is effective on all ore held in the corrugations, not on a thin film as where smooth (new) tires are in use. Rolls differ from Chilean mills in this respect: when corrugated their capacity lessens; still, by what I have elsewhere described as the "choke-feed," they can be made to treat a thick stream, grinding the dry ore upon itself with increased capacity and finer product. The Chilean mill, however, will do all this wet, and do it better. This is at once the secret of its

success as a fine crusher and the cause of its sliming action. For fine comminution, attrition in some form is necessary ; in hand-work (cutting down samples, for example) a hammer can be used effectively for a time, but on the bucking-board every one believes in the grinding action of the muller. The machine that depends on a blow alone cuts but a sorry figure in fine crushing, and should not be classed with such machinery. For this reason I have long held that the stamp is not a fine crusher because most of its work is done by impact, and but little by attrition, a fact that is gradually being recognized.

Rolled steel tires and dies have proved best in our practice, such for example as the Midvale and Latrobe brands. The wear and loss of steel on last year's campaign of 87,814 tons crushed, works out as follows :

	lb.		%	%
Tire steel worn.....	0·367		59·2	
Tire steel scrap.....	0·063		10·1	
		0·43		69·3
Die steel worn.....	0·153		24·8	
Die steel scrap.....	0·037		5·9	
		0·19		30·7
Total steel per ton crushed		0·62 lb.		100·0

The crushing pressure in the Akron mill is fairly heavy. Assuming a roller rests in ore, on the die, for one inch of its circumference ; or, in other words, crushes one square inch of ore per inch of face ; then the crushing pressure on the 6-ft. mill is about 900 lb. per sq. in., the roller with a new steel tire of 8 in. face weighing about 7200 lb. The crushing pressure is no doubt augmented slightly by centrifugal force, particularly if the rollers are run with a slight inward inclination on top. One great advantage of the Akron mill is the ease with which the rollers can be adjusted and the drive-head raised or lowered while the mill is running. See Fig. 3.

TELLURIDES are friable, and while the fine is richer than the coarse ore in most cases, yet the ores of Cripple Creek afford the greatest contrast in this respect. From the lumps that will pass through a 2 in. grizzly to the dust caught in the rafters of the mill the finer pieces and particles are invariably the richer. Advantage has been taken of this fact, and extensive experiments conducted to determine the best method of crushing and the most economical size of reduction. It was recognized from the first that Cripple Creek sulpho-tellurides were most difficult to cyanide by any method known to me, apart from roasting, consequently concentration was chosen as the sheet anchor of the process, and every effort was put forth to remove by concentration, in advance of the final cyanide treatment, all the sulpho-tellurides possible in both slime and sand.

The ore of Stratton's Independence appears at first glance to consist of a rather sparse scattering of sulphides in phonolite and phonolitic breccia; on closer examination it is found that the gold occurs chiefly as films along fracture-planes, or in cavities, or in small

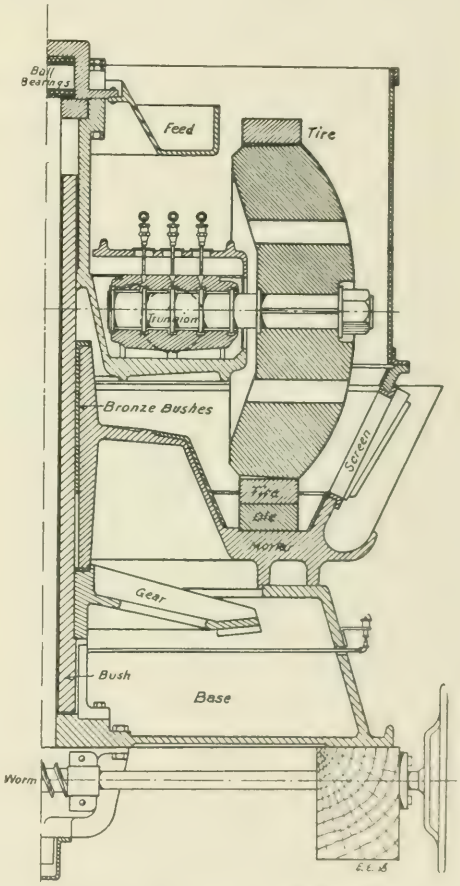


Fig. 3. Section of Akron Chilian Mill

veinlets ; the sulphide in the body of the rock is invariably low-grade, and occasionally worthless. To crush the rock fine enough to liberate all the sulphides was out of the question on account of the cost, the dressing loss in concentrating slime, and the low-grade product obtained from the concentrators. Experiments were made with rolls, stamps, pans, and Chilean mills, the latter giving the best results. Then followed experiments with size-crushing on a full working scale, made through screens varying from 0·02 to 0·10 in. aperture.

The best average results were, however, obtained around 0·046 screen aperture, which on $3·25 ore give us a sand-tailing averaging, after concentrating, about 80 c. per ton, and a slime running about $2 per ton after concentration, both products being subjected to further cyanide treatment. We have always failed to get any of the slime-tailings as low as the sands, either in the concentrating or in the cyaniding department. Another argument against further reduction of the sand might be predicated on this fact.

The guide, chosen after months of experiment, is not to allow the sand-tailing from the table to exceed $1 per ton; when this limit is approached a finer screen is used on the mills. Comparatively coarse crushing, and eliminating 40 to 50% of the ore as sand, with a poorer tailing than we can obtain from the slime, is one of the nice points in our practice, not generally seen or at least understood by either the casual observer or the critic. Here the physical character of the ore is utilized to obtain: (*1*) a coarse sand from which a high-grade concentrate (carrying 5 to 7 oz. gold) and an almost worthless tailing is produced in one operation; (*2*) An enriched slime from which a high-grade concentrate can also be obtained, leaving but 50 to 60% of the original ore for special treatment, such as air agitation, oxidizing chemicals, and filtration.

CONCENTRATION. — The sand from the Ovoca classifiers is automatically distributed to 20 Card tables or any lesser number, the machine being so arranged that one or more tables can be eliminated by merely inserting plugs in the divisions of the classifiers supplying them, while the supply of the idle tables is automatically distributed over the tables in operation. This distributor, as improved by the mill superintendent, is about the best I have seen. A similar one distributes the slime, and largely through their use one man on shift attends to 22 sand-tables, 4 vanners, and 13 Deisters. The tables once adjusted require but little attention so long as the feed and table-water are regular. Originally the sand was divided into plus and minus 40 mesh product, but the screens proved troublesome and expensive to maintain; later we found that just as good concentration could be done without them; our present practice is to make but one sand product and one thickened slime. From careful trials made in 1907 I decided that the Card table gave the best result on our sand, and I have been quite satisfied with its performance in the mill. The No. 3 Deister has done equally as good work on our slime as the modern vanner, and at less than one-tenth the maintenance. Vanner-belts do not last in our solution over 9 months; they cost about $120 delivered; this item alone would maintain a Deister table for several years. Then the rollers, gears, etc., on the vanners, require careful attention, and are a source of constant expense.

I have shown how the residual value of the sand is controlled by the size of the aperture in the screens of the Chilean mills; we have, however, another controller in the second concentrate produced on the general tables, inasmuch as by drawing off a greater or smaller amount of 'seconds' and middlings for re-concentration and re-grinding all the tail in a tube-mill, the tailing discharged from the general tables is largely modified. Furthermore, it is obvious that the production of this second-class material for re-concentration and tube-milling, renders possible the comparatively coarse crushing in the Chilean mills, through which a high saving of granular sulpho-telluride is made, that if slimed in the first instance would entail a great decrease in the gold recovered by concentration and incidentally a higher final tailing from the cyanide plant. To summarize, crushing through 10 mesh 0·046 aperture screens is made possible by returning a concentrated middling product for re-grinding in a tube-mill preparatory to again entering the main circuit of the mill.

CYANIDATION. — After concentration the various sands are pumped to the Ovoca classifiers *C* 4 and *C* 5 in the cyanide department, to be separated from the final traces of slime. These classifiers give a sand practically free from slime and carrying from 15 to 25% moisture, as desired; they consequently perform a double service, slime separation, and sand dewatering. The clean sand delivered at the head of the classifiers is mixed with as much barren solution as will pass through the vat-filters during the filling process and sluiced through highly inclined launders to fixed points over the empty leaching-vats, or is moved there by reciprocating conveyors when sufficient fall cannot be obtained for launders; in either case the maximum solution that will pass the filters is brought with the sand to aid the distribution in the vats. Meanwhile, leaching continues throughout the filling process. We find the leaching rate uniform over the entire charge, notwithstanding that no mechanical filling device is used. This filling method was not invented, it grew. Elaborate filling precautions and devices found necessary

(with slimy sand) to prevent the slime from choking the charge wholly or in part, are absolutely unnecessary when the slime is removed before filling; the Ovoca classifier does this thoroughly, so, in a word, our practice is to sluice the ore into the vats and sluice it out again after treatment. Recently some over-enthusiastic advocates of the all-sliming method called attention to the expense of handling sand as compared with slime; even this argument falls to the ground, when sand-vats are filled and emptied by sluicing.

The slime is collected and agitated in steel vats of the form shown in Fig. 2. Air agitation is used after the method illustrated. The discharge from the central air-lift being dispersed, about 10 ft. below the surface of the charge, by a small reverse cone; in this way the upper portion of the charge is kept in brisk agitation by a surprisingly small amount of air. Sand, if present, sinks and is deflected toward the side of the vat by the lower cone; rapidly settling to the suction of the lift it passes up again and in this way is kept in active agitation. With us the granular portion of the slime requires all the agitation we can give it. Others have described our method of agitation in the technical Press, but I regret to say have drawn largely on their imagination. In the pneumatic type of agitator where the air-lift discharges above the surface of the charge, the compressed air escapes into the atmosphere before it is fully expanded, while in the method shown in Fig. 4 the expanding air is dispersed and keeps the whole charge, above the reverse cone, in brisk agitation, instead of that small portion of the charge within the central tube, as in the old style of pneumatic agitator.

The slime is worked in charges of about 70 tons, agitated in cyanide solution of varying strength, and, as required, given a final treatment with bromo-cyanogen.

The solutions are precipitated on zinc-shaving, the dried precipitate being ground to impalpable powder in a special tube-mill and sold to the refineries. At first we had much trouble in sampling the precipitate, and many disagreements with the refineries; since it has been ground to powder, however, we have had no trouble in determining the value of the product.

Power-Shovel Loading 4-ton Car.

Breaker Plant during Construction.

COST OF MILLING.—The mill reached the 10,000 tons mark in March 1911, and averaged a little better than 10,000 tons per month for the following three months, closing our fiscal year. I take the expenses for these months in analysing the cost:

Month	Tons	Cost
April	9,899	$11,892·55
May	10,277	12,840·91
June	9,945	12,587·21
	30,121	$37,320·67

Average: $1·239 per ton.

The mill receives one-tenth of its supply from a small breaker-plant where the low-grade mine-ore is crushed to about ¼ in. and conveyed direct to the Chilean mills. The dump-breaker cost is based on the ore actually mined from the dump, while the crushing and concentrating plant treats the entire tonnage from both mine and dump, less the waste picked out. Labour includes superintendents, and all salaried men employed in the mill.

DUMP-BREAKER.

		Per ton treated	
Power	$1225·00		0·0436
Operating labour	1314·50	0·0468	
,, supplies	133·16	0·0048	
			0·0516
Repairs labour	659·94	0·0235	
,, supplies	1253·12	0·0446	
			0·0681
28,078 tons	$4585·72		$0·1633

CRUSHING AND CONCENTRATING.

Power	$5862·75		$0·1946
Operating, labour	3238·11	0·1075	
,, supplies	354·38	0·0117	
			0·1192
Repairs, labour	2441·18	0·0810	
,, supplies	3530·36	0·1172	
			0·1982
Loading concentrate	289·41		0·0097
30,121 tons	$15716·19		$0·5217

CYANIDING.

Power	$1459·00		$0·0484
Operating, labour	4039·83	0·1341	
,, supplies	6264·03	0·2079	
			0·3420
Repairs, labour	1010·40	0·0336	
,, supplies	642·05	0·0213	
			0·0549
30,121 tons	$13415·31		$0·4453

MISCELLANEOUS.

Heating	$151·43	$0·0050
Water service	144·62	0·0048
Liability insurance	169·21	0·0057
Fire insurance	898·40	0·0298
Taxes	1400·87	0·0465
30,121 tons	$2764·53	$0·0918

RECAPITULATION.

Dump-breaker	$4585·72	$0·1633
Crushing and concentrating	5716·19	0·5217
Cyaniding	13415·31	0·4453
Miscellaneous	2764·53	0·0918
Mine-breaker	838·92	0·0169
30,121 tons	$37320·67	$1·2390

We are now in position to compare the original estimate made in March 1907, based on milling 10,000 tons per month, with the average actual cost per ton milled, in April, May, and June 1911.

	1907 estimate	Actual cost
Power	$0·30	$0·2943
Breaking, sorting, fine-crushing, concentrating, and mine-breaker	0·38 (without sorting)	0·4560 (sorting included)
Cyaniding	0·47	0·3969
Miscellaneous	0·09	0·0918
Total milling cost	$1·24	$1·2390
Mining and dump-loading	0·10	0·0891
Total mining and milling cost	$1·34 Estimated	$1·3281 Actual

The original estimate contained an item of 18 cents per ton milled, for treating the concentrate on the ground, making the total cost $1·52 per ton. This estimate covered everything. The two cents caused some amusement, as few believed it possible to figure such a process within 25 cents per ton; while many were unkind enough to say it would never be done under $4 per ton. The figures, however, speak for themselves.

The concentrate was not worked-up on the premises, as better arrangements were made with the smelters, so this part of the estimate cuts no figure, inasmuch as the cost is lower than my estimate of 1907. The concentrate varies from 4 to 7 oz. gold per ton, and averages nearly 5 oz. It contains about 30% iron excess over silica, and is otherwise an excellent and desirable smelting product, since it forms the ideal binder required in the Huntington-Heberlein or pot-roasting process. Hand-sorting was not included in my original estimate, nor was the extra cost of operating a breaker at the mine, partly to supply the fine-crushing and concentrating plant. These items increase the cost by 5 c. per ton; deducting this, the breaking, crushing, and concentrating cost becomes 40 c. as against an estimated 38 c. Cyaniding is 7⅓ c. below the estimate, due to improvements in agitating, in the general mechanism, and to cheaper chemicals than were available four years ago.

EXTRACTION. — During the fiscal year ended June 30, 1911, the mill treated

Tons		Oz.	Oz.
102,364	of dump ore assaying	0·152	15,564·91
7,436	of mine ,, ,,	0·231	1,724·05
109,800 tons averaging		0·157	17,288·96
		Oz.	%
The concentrate contained		7546·80	43·65
The bullion	,,	4814·80	27·85
Total recovery		12361·60	71·50

From the foregoing results it is apparent that the estimates of working cost and extraction have been translated into fact.

PROGRESS AT PORCUPINE

By H. H. JOHNSON.

THE Porcupine goldfield, in Ontario, Canada, is readily reached today by the new railway, which was opened for traffic as far as Golden City some three months ago.

In common with almost everything else in the district, Golden City was nearly wiped out by the recent disastrous fire, but with the advent of the railway it has been rebuilt with wonderful rapidity. Lying at the north end of Porcupine lake, it is more remote from the mines so far discovered than its sister city, South Porcupine, which is connected with it by a good service of motor-boats that make the single journey in from 10 to 15 minutes. The railway also connects the two centres, but the stations are situated too far from the main thoroughfares to render this means of transport of much account, especially while there is at present only one train a day in each direction.

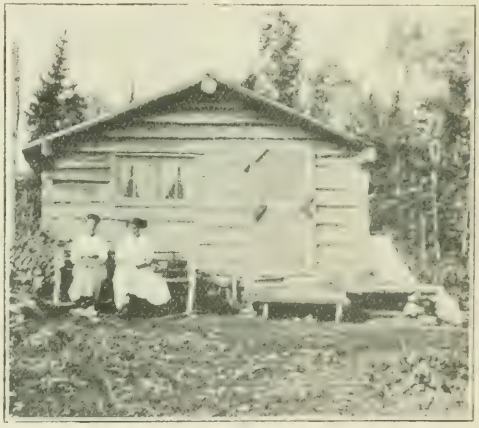
From South Porcupine the railway is being rapidly extended, both to the Dome mine to which freight is already being conveyed, and to the Hollinger group, which begin traffic in December.

The few roads in existence are mainly composed of 6 to 8 in. corduroy, laid on the mossy swamp; in summer, even to a poor walker pedestrianism is as agreeable as driving over such roads, but in winter, when they are covered in snow, the roads are said to be excellent for sleighing.

Of the immense number of claims staked serious work has so far been undertaken on comparatively few; the majority of claim-holders, having 'recorded' sufficient work to protect their titles, are apparently waiting for some more capitalists to come and relieve them of their properties at a handsome figure. It is significant that, although the camp has been visited by many leading engineers, few properties have changed hands, with the notable exception of those properties acquired by Bewick, Moreing & Co.

No doubt the check to the district caused by the fire in June has been accentuated by the small amount of work to be seen, and the extravagant prices asked for absolutely undeveloped claims; but there can equally be no doubt that when a regular output has been established, as it shortly will be, and when more inclination is shown to do genuine work in prospecting and development, the district will take a place in the ranks of recognized goldfields.

At the Dome mine, work on the surface is going on apace, getting necessary buildings ready for the winter, and erecting the reduction plant, all being of a permanent and solid nature. Further work has recently disclosed more showings of a similar nature to the so-called Golden Sidewalk, which is certainly a marvellous spectacular display. The company now keeps a watchman to show visitors some



A sign of progress.

of the rich outcrop, and to protect the latter from the 'high-grading' propensities of specimen-seekers. The 40-stamp plant is said to be going to start up in January, but from present appearances it is evident that it will require much strenuous work to get ready by that date.

From the point of view of the district at large, it is unfortunate that the courteous management is unable to make a definite statement as to their development assays, or allow visitors below ground. Of course, the company knows its own business best, and has a perfect right to please itself in this respect; but it would dispel a good deal of doubt and suspicion if it adopted a more open policy.

On the Dome Extension, there are a number of fine surface showings in a stock-work of veins, and exploration underground is being

energetically undertaken now that the new compressor plant and hoist are available. Capt. H. C. Anchor, an old and experienced miner, is in charge, and this is evidenced by the practical way in which the work is being done on the property.

The North Dome, with its rich outcrops, is both drilling and shaft-sinking, but surface water was troublesome, as it is with so many Porcupine properties. A new force of men is re-starting work on the Dome Lake claims, which are readily approached now through the West Dome. At the latter everything is in good shape for winter, and a great deal of preliminary surface work and shot-drilling has been done, but at the time of my visit most of the ore had not been sampled.

A shaft is in course of being sunk on a likely looking vein on the adjoining Apex claim, which is in charge of Mr. Anderson. On this property a core-drill is also at work, and good winter quarters are now completed. Here also water is causing some trouble.

The most noteworthy and certainly the most systematically worked mine that I visited is the Hollinger; here the surface has been thoroughly explored, and the veins to the number of ten stripped and carefully sampled. The main vein has been proved for over 1100 ft. on the strike at the 100-ft. level, and driving on the same vein is proceeding from the bottom of a winze on the 200-ft. level. The new main shaft has been holed through from the first level to the surface; rising has started from the second level, and the double-drum electric hoist, for operating the shaft, is in place, together with the electric-driven compressor. Good progress is being made with the foundations for the new 40-stamp mill, which it is hoped to start in May. The railway will terminate in the Hollinger township west of Miller lake on the property, and should be handling traffic early in December, as already stated. The general management is in the capable hands of P. A. Robbins, who has had large experience in South Africa, Cobalt, and elsewhere, and he is ably seconded by W. Globe, the assistant manager.

The underground workings afford the best insight into the character of the Porcupine veins so far discovered; it is evident that their lenticular nature, as exposed on the surface, is a regular feature, and they frequently develop that stringy appearance so common in quartz veins when traversing a schist formation. The enclosing schist is also said to carry gold, but it appears certain that it is pay-ore only when minute quartz stringers are foliated with the schist, as frequently happens. So far water is not proving a difficulty, and this bears out the opinion generally held, that although the district is swampy and contains many lakes and rivers, mining is not likely to be hindered, if the surface water is handled properly.

In the neighbourhood of the Hollinger are several properties of considerable promise, on which systematic work is being done with varying degrees of success. Among the principal of these is the McIntyre, which owns the ground adjoining the west end of Pearl lake, together with nearly the whole of the lake itself. This property has earned distinction from the phenomenally rich outcrop found on its southern border. In addition to several core-drill holes, four shafts have been sunk on various veins to 100 ft., and a fifth shaft has recently been started. The main shaft, No. 4, is down 30 ft. below the first level at 100 ft., and progress at the rate of 25 ft. per week is being made in it, as well as in the southeastern shaft. Nearly 150 ft. of driving has been done in the vein at the first level from the main shaft, besides cross-cutting, and the vein is looking strong and carrying good ore, though it is disturbed in the eastern face. A bore-hole put down near the centre of the property penetrated an orebody for 42 ft. assaying 7½ dwt. per ton. So far it does not appear that this vein has been opened up in any other way, most of the work being confined to the veins outcropping either on the southern boundary or north of the lake on the claim adjoining the holding of the Pearl Lake Gold Mines. There is in operation a 12-drill steam and electric-driven compressor, which has enabled a forward development policy to be adopted, and the original decision to erect a mill immediately has been wisely postponed for the time being, until further data are available to enable a choice of the size of plant most suitable.

On the Pearl Lake mine a great deal of useful work has been done. The position of these claims, in relation to the Hollinger, makes them of considerable potential value, but it seems probable that in depth they will also catch a number of the veins of the Dixon, McIntyre, and Jupiter properties. Indeed, this has to some extent been proved by bore-holes put down near their south line, for these have encountered pay-ore at depths ranging from 300 to 400 feet.

On the opposite side of the lake is the Schumacher block, which has also wonderfully rich surface showings. It is said that the as-

says are so high that they are "frightened to publish them!" It is regrettable that so little work has so far been done on so promising a property. Further south the Vipond is doing good work in shaft-sinking and driving at the 100 ft. level; in the cross-cut at that level the No. 3 vein assays 8·6 dwt. over 20 ft. width.

Up till now the township of Tisdale has furnished most of the promising properties; gold has, however, been found over a wide area in small quantities, and it will be surprising if further prospecting does not reveal more mines.

The Sandy Falls power scheme is practically completed with the exception of stringing the wires on the poles, and this will prove a great boon, though the price it is proposed to charge, namely, £20 per kilowatt per annum, based on a three minutes peak load, seems capable of adjustment.

In the course of a visit of only a month's duration, it was manifestly impossible to see more than a few of the more important properties, from which, however, the impression is gained that in some instances work has been carried on under almost insuperable difficulties prior to the introduction of the railway; but it seems that in the past much too much money has been spent in drilling, and too much importance given to the results so obtained. The veins are highly lenticular, both in strike and dip, and the only convincing manner of prospecting must be to find the orebodies at the surface and sink on them and stick to them as far as possible throughout. There is a pronounced similarity between Porcupine and Rhodesia, and it appears probable that though the former may produce big mines, it is more likely to be a country of comparatively small mines, like the latter.

There is an idea prevailing that those properties lying to the northeast and southwest of the principal mines are certain to contain the veins of the latter and hence are the most valuable areas in the district. Too much weight should not be attached to this theory, for in the first place although many veins do strike more or less as indicated, this is by no means universally the case, and secondly there is no proved reason why profitable veins should not be found anywhere in the large tract of schist country.

THE DOME EXTENSION AFTER THE FIRE.

The facilities for working are distinctly favourable, water is abundant, medium mine timber fairly plentiful, while coal and other supplies can be landed in the midst of the district at quite reasonable prices. Labour is also being attracted at rates that compare favourably with those existing in the Western States mining camps.

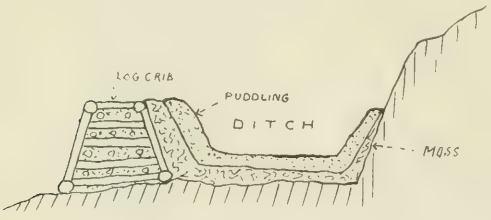
The over-capitalization of so many of the claims, on the American principle of millions of dollars in paper, is unlikely to commend itself to the intelligent European investor, and it will be a pity if initial errors of this nature are allowed to cripple a mining district of distinct promise.

RECENT PROGRESS ON THE KLONDYKE

By F. L. MORRIS.

PRACTICALLY the whole of the mining district of the Klondyke is at present either owned outright or held under option by one of the following companies: Yukon Gold Co., the Granville Mining Co., or the Boyle Concession. Each of these companies has expended large amounts of money in the development work on a big scale, and each has been successful in accomplishing results that at one time seemed unlikely in a country so far on the Arctic frontier.

The largest and most completely equipped of the companies is the Yukon Gold. This company has in operation one of the most successful and largest ditch and hydraulic mining systems in the world. The total length of the ditch system is over 60 miles.



Cross-section of the Yukon Ditch.

The inverted syphon of this system, which crosses the Klondyke valley, carries approximately 5000 miner's inches (125 sec. ft.) for two miles under a pressure of 450 lb. per sq. inch.

This system has been in operation for three years. During the past summer it has given but very little trouble. The force of men employed on repairs and patrol has been reduced to approximately the number that would have been necessary had the same system been installed for the same length of time in California. The effects of the use of this water-supply has begun to show itself by the large pits excavated in the hillsides through which passes the White Channel of Bonanza creek.

The most noteworthy point in regard to this ditch-system and its operation is the high duty attained in washing the gravel; this amounts to 5 cu. yd. per miner's inch in 24 hours. The average duty per inch in all of the hydraulic mining in California will not be far from 2 cu. yd. per miner's inch. This point, next to the gold-content of the ground, is the most important to the operator.

The Yukon Gold company has 9 gold dredges in operation. Two of these machines were constructed during the past season. They have steel hulls and a bucket capacity of seven cubic feet. It may be added that they are the only dredges with steel hulls in operation at present on the North American continent. The general design is the same as the wooden hull. The machinery is identical. The cost of installation is but little more and the general operation is expected to be more satisfactory.

In addition to the innovation of the steel-hull dredge, this company has accomplished what would at first seem to be impossible in the way of handling heavy 'block' bedrock. Two of their dredges are working in the most difficult hard bedrock found in the Yukon, and are handling it successfully to a depth of eight feet in some places.

The tailing-piles left by these dredges could be likened to a waste-dump from a quartz mine as to appearance, which they more resemble than the ordinary dump made by a dredge digging alluvial gravel. However, it must not be taken for granted that a machine built on the same design as the Yukon dredges could dig into and handle as hard a schist as would be found in other parts of the world, because the only reason that it has been possible in this instance is that the gravel and the bedrock have been frozen, thereby wedging the particles apart by the expansion of the ice in the rock crevices.

Probably 80% of the ground dredged by this company is solidly and permanently frozen. This ice is removed by steam-thawing. There has been little change in the system of thawing during the past year. This part of the work has received a great deal of attention of late and the cost will no doubt be reduced slightly next season. At present, the cost of thawing is over one-half the total cost of working the ground.

The Boyle Concession Co. is operating two dredges, both designed and erected by the Marion Steam-shovel Co. Their property lies in the valley of the Klondyke river, the bed of which is partly thawed. Their dredges

to date have been working on ground that was naturally thawed, thus reducing the working cost to a much lower figure than that of the Yukon Gold, which is compelled to incur the immense cost of artificial thawing.

Among the noteworthy results accomplished by this company is the erection of a 16 cu. ft. dredge on their property in the summer of 1910. This dredge was the first of this large capacity ever built anywhere. It was thought by many of the best dredge-operators of the United States that it was a mistake to build so large a machine as this in a country so inaccessible as the Yukon for the reason that the breaking of one important weak part would mean the loss of the whole of a season's operations. Nevertheless the machine in question has been run successfully for part of 1910 and the whole of the season of 1911 without a serious breakdown, and it can be said after this test that the machine is successful. Its capacity is as large as if it had been working in the mild climate of California, namely, a maximum of 13,000 cu. yd. per day for a whole week.

The Granville Mining Co. represents the properties consolidated by A. N. C. Treadgold. This company as yet has not begun mining operations. The holdings are chiefly composed of claims on the Dominion creek side of the divide, while those of the Yukon Gold and the Boyle companies are on the Klondyke slope of the divide.

The chief work accomplished by this company since its organization is the erection of a large power-plant to be used in conjunction with the mining operations, and also as a commercial plant furnishing power to other local mining companies. This plant has a capacity of 10,000 kw., in two units, both of which are in place and ready for operation when desired. At present it is supplying all the motive-power for the Yukon territory. It is assumed that this company will undertake to mine its properties on lines different from those at present in vogue locally. It is to be hoped that these will be as successful as the installation of the power-plant. The control is in the hands of experienced men including H. C. Hoover, A. C. Beatty, and H. H. Webb.

LAYING WOODEN-STAVE PIPE FOR THE YUKON GOLD CO.'S WATER SYSTEM.

MINING METHODS AT BRADEN, CHILE

By FRANK LANGFORD.

THE mining of ore has been less discussed in detail than ore reduction ; this will be a sufficient apology for the accompanying outline of a system in deep mining that will rival, in low cost, the use of the steam-shovel in surface operations.

It is a modification of the plan first put into practice at the Melones gold mine in California in 1900 and elsewhere since then by myself, with the aid and advice of such eminent consulting engineers as Messrs. W. B. Devereux, William Braden, and Pope Yeatman. In its simplest adaptation the method consists in driving a drift under the first level on the orebody to be mined, raising chutes, manways and passes at an angle with the vertical of 45°, the stope being simply raised from the loading chutes along the level and filled with broken ore, the surplus being drawn out through the chutes without sub-level, grizzlies, or other detail ; likewise the filling when the stope is completed. Many difficulties were anticipated, such as the weight of two or three hundred feet of broken ore on the loading chutes ; blocking of the chutes with coarse ore ; dangers in extending the stopes overhead to the next level, which had been drawn, or might be full of broken ore, putting 400 or 600 feet of ore on the chutes below ; the fear that if the ore were soft and fractured the backs could not be supported or made safe on the moving fill, upon which the machinery had to be set and operated ; the fear that if the rock were hard enough and tough enough to stand in large open backs it would not break fine enough to pass through the chutes ; and so forth.

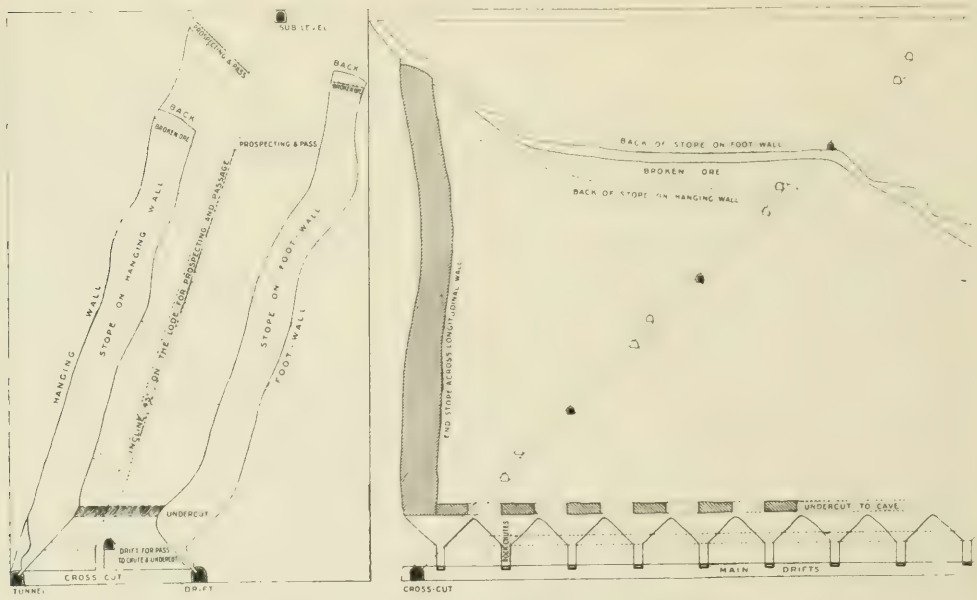


DIAGRAM ILLUSTRATING METHOD OF MINING.

The actual result was that more than a million tons of ore was mined with a record of only one man killed by a fall of rock in the stopes, one by falling down a main shaft, and one by contact with a 440-volt electric current. Moreover, the ore was got for half the cost, and the rate of pay of labour was 10% higher.

Referring now to the accompanying sketch. It is an outline of my general plan of mining the more regular and deeper orebodies of, in this case, the Braden Copper mines of Chile. These consisted of fractured material with a good tough hanging wall-rock and a foot-wall country carrying considerable copper but not definable, except by sampling and assay. The workings consist of :

1. Drifts near the hanging and foot-wall, respectively, and a cross-cut.

2. Rise 45° on centre of orebody to the level above.

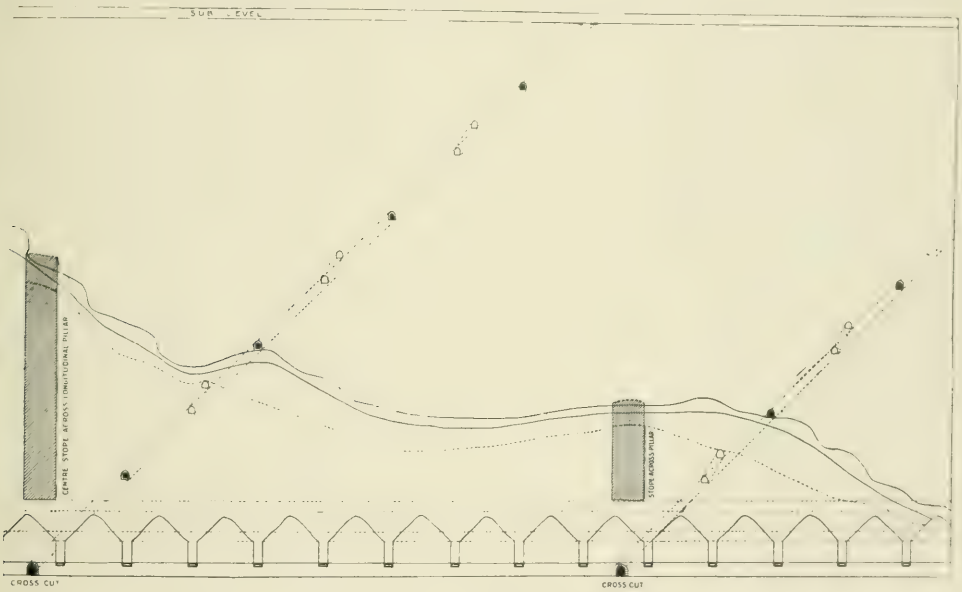
3. Cross-cut from this rise, to hanging and foot, at distances of 15 metres alternately to prospect the orebody, define its limits, and furnish easy access to the stopes continuously, as they are enlarged and filled.

4. Rise loading-chutes to 3 metres above the drifts at intervals of 9 metres.

5. A shelf or loading ledge cut at 6 metres over the main level behind the loading-chutes to facilitate the blasting of boulders in the chutes, and as part of the final under-cut in narrower orebodies.

In the wider orebodies proceed as outlined above and in addition drive a central drift, or rise from the cross-cuts on the level to about 9 metres above the main level and there under-cut the central rib in pillars preferably on a level plane, as shown. Extend the hanging-wall stope, the foot-wall stope, and the cross-connecting stopes simultaneously. When completed to the level above, which has been worked out, and while the stopes are full of ore, shoot the pillars slowly from one end of the orebody, permitting the central rib to settle slowly, thereby crushing the rock fine enough. In the case of a free and well defined hanging-wall slip, the hanging stope may not even be necessary. Main supporting pillars and man-ways may be left in the lower grade sections of the mine, if desired; the purpose here being, not to show what might be done, but to show the least work that will win the ore safely, surely, rapidly, and at the lowest cost. While it may be said at first glance that special conditions are essential to the employment of this system, it will be seen by a little study that it may be employed in many mines of modern type, always with modifications to meet local conditions, a precaution that is much advertised in connection with milling and metallurgy, while in mining it is often left to chance or to a trail blazed by underground prospecting.

As an illustration of the flexibility and of the modifications suggested or dictated by varying conditions, I would site the practice in three places.



CONTINUATION FROM OPPOSITE PAGE.

First. At Melones, in California, each ore-shoot was mined in one long-wall stope of any length and of widths up to 75 feet without under-cut or caving and without sub-levels or milling the ore through grizzlies underground.

Second. At the Fortuna No. 2 mine, in Arizona, where for many reasons, such as the unknown width of the orebody, the fractured nature of the ore-bearing rock, the commercial requirements, etc., the stopes were laid across the orebody in room-and-pillar form.

Third. In the deeper Braden orebodies, in Chile, where the system has been amplified and modified as shown in my sketch herewith to meet the requirements of preparing large areas of stopes, to facilitate the economic min-

ing of more than 4000 tons daily, until the drawing of corresponding filling and pillars can begin, and the requirement that in such preparation of large stoping-areas as little ore as possible be mined, on account of the lack of mill-capacity and power until such time as the new 12,000 hp. plant and the 2000 ton concentrator were ready.

The points aimed at are:

1. To develop the most ore with the least work.
2. To make the prospecting and the development work serve best for mining and drawing the ore.
3. To allow the greater amount of ore to mine itself.
4. To avoid the use of timber.
5. To permit the drawing of stopes evenly over large areas, a desirable precaution in preventing the mixture of waste from the walls with the ore; although this is an evil too much feared in many cases of tough hanging and of country carrying some ore.
6. To facilitate the drawing of a large part of the ore direct from the stopes to the lower haulage-levels by branch rises from the main ore-passes leading down 1000 ft. to the main haulage or mill-level, such main ore-passes being also on inclines of 45° to 55°.
7. To cause the ore to crush itself in caving fine enough to be handled at the chutes.
8. To permit easy access of the miners to the stopes and without hoisting.
9. To provide good ventilation in the stopes.
10. To facilitate supervision.

At the Melones air-drills of the largest sizes were used.

At the Fortuna smaller or $\frac{3}{4}$ in. piston drills were used.

At the Braden the air-feed hammer-drills are used.

The length of hole usually drilled per shift with each machine in place was 60 ft. for the big machine, 45 ft. for the smaller piston-drill, and 100 ft. for the hammer-drill. The efficiency must not, however, be measured by the feet drilled. The comparison is given more to show the wide range of machines employed in the same general mining plan under different conditions.

The cost of this system may be indicated by quoting the results at Melones during the year October 1, 1908, to October 1, 1909. During this time 94,300 tons was raised from the stopes and 12,800 tons taken from the surface; the quantity milled was 123,200 tons. The cost of mining, including development, was $41,014 or 39 cents per ton, and the total cost $125,075 or 87 cents per ton. During one month the costs were as low as 32 cents and 79 cents respectively. These are low figures; indeed, they are, I believe, the lowest figures ever reached for deep hard-ore mining, milling, and concentration under conditions not by any means ideal. The cost for milling, amalgamating, and concentrating, and the saving attained on ore containing much of the value in tellurium and requiring fine concentration should make the 'porphyry' operators put in a little over-time to explain their triple cost and their triple losses. At the Fortuna the corresponding cost for mining was 46 c. per ton. At the Braden not enough actual stoping has yet been done to fix the cost of mining, but it should not be more than half that of the Melones.

The introduction of this plan of mining has met with considerable opposition in each case and has been subjected to the criticism of the Comstocker, deprived of some fancy timber-framing; of the sealed-bag travelling engineer, deprived of the chance of applying formulas for estimating ore; and of auditors who would show capital 'locked-up' in broken ore, when in fact the ore broke itself.

I have been most fortunate in having splendid assistants from time to time, like Mr. Locke, Mr. Kett, Mr. Williams, and others, with open minds, experienced, but unmarried to inherited methods of mining or cost-book prices of milling.

British Coinage during 1910.—The report of the Mint for 1910 just published shows that the output of gold and silver coins was the largest on record. There has lately been a rapid increase in the demand for gold coin, and the value of those produced in 1910 was £22,891,564, as compared with an average of 12½ millions during the preceding ten years. The following table gives a summary for 1910:

Coin.	Number.	Value.
Sovereigns	22,379,624	£22,379,624
Half-sovereigns	5,023,881	2,511,940
Half-crowns	2,557,685	319,710
Florins	5,650,713	565,071
Shillings	26,547,236	1,327,361
Sixpences	12,490,724	312,268
Fourpences (Maundy)	2,755	45
Threepences	4,564,820	57,060
Twopences (Maundy)	2,998	24
Pence (Maundy)	3,392	14
Pence	29,549,184	123,121
Halfpence	10,769,920	22,437
Farthings	2,598,400	2,706
Totals	122,141,332	£27,621,387

EARLY DAYS ON THE RAND

By D. B. SCHUITEMA.

IN June 1884, I travelled with the Vice-President of the Transvaal, Cornelius Bodenstein, from Pretoria to Potchefstroom. We left Pretoria about 7 o'clock in the morning and slept that night at the Jukskey River hotel kept by a man named Edgson. Starting the following morning at 6 o'clock, we came about half-past seven to a farm which I believe now was Waterval, which adjoins Randfontein. Mr. Bodenstein said to me: "Do you know we are now driving over a goldfield?" I asked the old man: "What do you mean, Oom Cornelius?" "Well, what I tell you; we are driving over one of the richest goldfields in the world." As I was well aware that the Transvaal Government was then hard-up for cash, I said: "But why does the Government not throw the ground open as a public digging, or work it themselves?" "Well, my dear Sir," the old man answered me, "I am afraid it will have to be done some time, but we are afraid that the English will then take our country again."

This was shortly after the first Boer war of 1881. At that very time a deputation consisting of President Kruger, General Smit, and the Rev. S. J. du Toit, then Superintendent of Education, was in Europe to arrange for the alteration of the Convention. Many a time since have I thought of the old man's words, as the Witwatersrand goldfield was certainly the cause of the second Boer war.

Mr. Bodenstein, I am sure, alluded to the discovery of alluvial gold and also of gold in quartz veins then already made by a certain Minaar, from Potchefstroom, who with the assistance of people from Pretoria commenced working the farm Kromdraai on the Jukskey river, north of what is now Krugersdorp. A German named Hammerschlag had also found gold on a farm about 3 miles farther, north-west of the Crocodile river. At this place the gold was in a large white quartz outcrop, and he floated a company in Natal in 1885.

It must be understood that none of these men were mining experts or engineers, for up to that time gold had been found only at Pilgrim's Rest (Lydenburg) and what is now the Barberton district, in quartz veins. Nobody searched or prospected for gold in any other formation. To prove that even as late as April 1886 it was not generally recognized that gold existed in the banket formation, it is known to me that the same Mr. Hammerschlag had a contract with the owner of the eastern portion of Roodepoort, on which are now the Durban Roodepoort and United Roodepoort mines, to prospect for gold, with an option to purchase. He abandoned this option on April 1, 1886, as his prospector could not find enough gold in the white quartz leaders.

It was about the commencement of the year 1885 that another Boer, named Laurenz Geldenhuis, found a rich deposit in the hills to the north of the farm Roodepoort, close to the Hospital Hill shales. He showed his find to the owner of the farm—Harry Struben—who had bought the land from him for agricultural purposes. The assay-value of the piece of ore (a mixture of shale and quartz) taken from the surface and about the size of a horse's head, was 900 ounces of gold and 300 ounces of silver per ton. Mr. Struben, who was at that time already well off and had had some experience in the diamond fields and at Pilgrim's Rest, erected a 10-stamp mill in the 'kloof' about two miles north of the present Main Reef series, before having opened up any mine. This mine proved a failure, as it was only a blow, but all the same this discovery was the commencement of a fortune for Mr. Struben, as he secured mining leases on farms in the same line of hills, the majority of the ground lying south and containing what is now known as the Main Reef. Among others the farm Vogelstruisfontein (now Vogelstruis Estates) and also the farm Elandsfontein, on which is now the Geldenhuis Estate, were secured by him.

In December 1885 I visited his mine with my brother-in-law Dirk van Breda, who was a gold-digger from Barberton. The Master of the High Court and Orphan Master, Jan Joubert, hearing of my intended visit, asked me to see about a farm in the neighbourhood, that is, the western portion of Roodepoort. The farm was mortgaged at the Orphan Chamber for £500 and he wished me to buy it for £700, so as to close the estate. We looked from the top of the hill on which Struben's mine was, down toward Roodepoort, but never visited the farm, as it was rather late. On asking my brother-in-law what he thought, whether the farm had any chance of being

gold-bearing, his reply was : " I would rather look for diamonds than for gold there "—a characteristic answer from a man who had been in his early days on the diamond fields and later at Pilgrim's Rest and the mountains of Barberton. I only mention this incident to show what was thought to be the real value of the Rand farms at the end of 1885. This same portion of Roodepoort was in 1886 sold for £10,000 and the buyer floated it into a company known as the Princess Estate.

About March 1886 there arrived at Pretoria a Scotch cart drawn by four miserable donkeys ; the Stars and Stripes were flying on one side and the Transvaal flag on the other. The owner of this cart was a prospector well known at Pilgrim's Rest ; it was Dick Hart, a real old-fashioned character of the Bret Harte digger type, always with his little stump of a pipe in his mouth, and talking with a Yankee twang ; ever ready to take a drink, or to stand one, at the nearest public-house, which in this case was a small tavern called the ' Hole-in-the-Wall.' He was always telling a yarn or tale, coming back in a mysterious way to a marvellous rich discovery he had just made of a goldfield at least 30 miles long by 3 miles broad. Old Pretorians will remember him standing with his cart in the market square, the cart containing, among the pots and pans and his bedding, lots of bags (from the size of the small money-bags of the Standard Bank of South Africa to the 50-lb. Natal sugar bags) filled with a rock in which no one had ever seen any gold. Old Dick panned this rock in our presence at the water furrow running in front of his cart in the market square. He showed us the gold in the dish ; he showed us the results of his pannings in little bottles ; he showed us the black sand with the fine gold visible between the sand in the only saucer he possessed ; but I am sure most of us looked on him as a cheat or a conjuror.

Hart asked from the Government £1000 sterling for showing them the place from which he had obtained his ore.

At that time I had already a little experience in gold-washing through my visits to the Devils Kantoor and the Barberton goldfields, where my brother-in-law worked. One of my friends, a Cape Colony Africander, by name of Gert du Plessies, who had been with Dick Hart in the Lydenburg district, very soon got from the latter an inkling as to the whereabouts of the new discovery, and he suggested to me that I should support him with wagons, oxen, tools, and provisions, so that he might find out by prospecting on the Witwaters Rand where this wonderful ore came from. As I did not much believe in the business and partly also as money was rather scarce, I could not act on his suggestion, and a few days later he got Japie de Villiers, a rich inhabitant of Pretoria who had been in his early days in Australia, to support him. The outcome of his trip was, I may here mention, that he got hold of the piece of ground now belonging to the Robinson Gold Mining Company. He had secured the mineral rights on this piece of land for 20 years at a yearly rental of £100 from the owner, Piet Bezuindenhout, with six months free for prospecting. When his prospecting period was nearly finished, he sold his half-interest to J. B. Robinson for £1500 cash and 3000 shares in a company to be floated with a nominal capital of not more than £50,000. His supporter, Japie de Villiers, sold his half-interest a few months later for £15,000 cash. During the boom time of 1888–'89 the company was reconstructed with a capital of £2,750,000, the original holder of the 50,000 shares taking for each one pound share 10 shares of a value of £5 each and setting aside £250,000 for working capital.

Dick Hart was still trying to get £1000 from the Government for telling them where this wonderful goldfield was, but even before Gert du Plessies, another citizen of Potchefstroom, Mr. Bantjes, had found out that gold existed in the banket, as the rock was then called by the Boers, this name being given to it by them because of the pebbles in the sandstone reminding them of the almonds and raisins of a Dutch cake called ' banket.' Bantjes organized a small syndicate at Potchefstroom in April 1886 and secured mining rights on the western portion of the farm Paardekraal, which property is now called the Bantjes Gold Mining Co. He showed his discovery to Struben, who, as mentioned before, had the farm Vogelstruisfontein adjoining Paardekraal. Struben commenced prospecting there and the sons of Laurenz Geldenhuis started prospecting on the farm Elandsfontein, now the Geldenhuis Estate.

In the meantime a rich discovery had been made at Barberton, namely, the Sheba, which attracted the attention of the financiers of Kimberley. They sent their engineers and agents to Barberton, but as they had to pass through Potchefstroom and Pretoria, where they heard of the new discovery on the Witwatersrand, many of them turned back from Barberton to the goldfield that eventually proved to be the greatest of all.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

A Miner's Protest.

The Editor:

Sir—"This magazine is tied by no strings save the cord of sympathy with all those that go down the mine in skips." The above, and the statement of Mr. Hays Hammond to investors, talking of the shyster mining engineer and the unscrupulous promoter: "blame not the honest miner, whom I have met in the tundras of Alaska, fever-stricken plains of death valley, and found him confident, upright, brave, and a man of generous impulse"—I am quoting from memory—encourage me to address you on behalf of my fellow Rand miners.

Even in your journal some few quondam Rand managers—I marvel why their houses did not retain them—frequently proclaim aloud the inefficiency of the white miner. The Press at this end is subsidized. Journalism as a noble calling does not exist. An editor is wrung-up by one of the houses, his leaders are inspired, his tone is coloured, his policy is shaded by his patron.

To return: It is against logic and the weight of evidence to assert that the Rand miner is inefficient. The little that some of our critics do know concerning the breaking of ground they were content to acquire from some of us. No miner however goodnatured gives his last saving item of experience to the casual learner whose loyalty he distrusts. That same knowledge given may be used against him in time of strike. The miner must conserve. His profession is occult. He is dealing with forces or factors that cannot be determined by mathematical precision. The exploding force of powder and the breaking strain of a rock cannot be exactly correlated. Hence the divergence of methods. Who can tell a miner to burden this or that hole more or less?

In other trades the best market attracts the most skilled men. I believe we have the best miners from Europe, America, and the Colonies. It is the system for which the managers are responsible that is bad. Read the Regulations and spare me the judging. We never hear of bad managers. Rand managers are unique. They have the strongest Association in the world, for they all belong to it; yet they object to their miners being union men, and black-list them from end to end of the Reef, and brand them as agitators in the gutter Press, that heir of their adoption. The miners receive four dollars per day at stope-work—a trifling wage considering the relative purchasing value of money here. Machine-work averages five dollars. A machine-miner does his work for six years and then dies. Phthisis is the scourge. As a contractor he is at the height of his producing power for about three years in the middle period; at the start he is acquiring skill; at the end he is weakening. Still Lionel Phillips says that the Rand miner is paid too much. The miners know as well as Mr. Phillips that the mines are profiting by the exploitation of Kaffir labour, and being human they desire a share of the boodle. The miner takes his life in his hand when he goes down in that skip you mention; it jumps the rails twice a week in the average Rand mine; he converts the useless latent power of the native into a useful profitable asset. It is a psychological peculiarity of the native that his ideas of direction and motion are round. It may be environment. His first idea is circular. It may be fashioned from the sun and moon, as his education proceeds from observation only. True it is, that all their fortifications are circular, his utensils, his hut, threshing-floors, wicker cages, baskets, pottery, and cooking gear are round. I have put in four pegs for a rectangular prospecting pit in Rhodesia and started a native accordingly. I came back in three days. It was a circular pit. The savage reverted to type. Therefore the native cannot be a miner, and the Rand miner is therefore the greatest creator of wealth for his company, as he controls 30 boys as his quota, whereas the skilled artisan or engine-driver only averages one boy, and then more in the manner of a body servant than a labourer. Why then should the mining bosses single out the miner for sharp practices and cutting devices? Think of the dangers and the pitfalls of the mining Regulations. You are liable not only for your own transgressions, but for everyone of those black men. As much as £20 is a common fine imposed on a miner when proved guilty of a transgression. If you cut a 'boy's' ticket for not drilling 3 feet or allowing his hole to deviate, he may either crack your head with his 4-pound hammer, or light a fuse in a charged borehole, or more often violently pull the fuse from its anchorage. These are a few of the Rand miner's grievances. Another real grievance is the Identification Pass (an outcome of the strike) that the miner must carry. It lends itself to blacklisting, as a shorthand stroke half-hidden denotes a lot, after the fashion of a marked coin in the trapping system. Espionage and nepotism are rife. According to the Ordinance of 1903, to obtain a

mine overseer's certificate you must have one year's charge or under-charge of the underground works, that is, you must become a shift-boss. That billet is the gift of the manager; the position connotes a knowledge of mining, but it is not borne out in fact. The man selected may possess a blasting ticket, as is often the case. So the best billets are conserved for one class or persuasion.

One more word—I fear I am trespassing, yet I refrain from flattering you: How about the bad managers. Walk through the drifts of the Rand mines, and observe where the seam or reef is faulted, whether it was a normal, reverse, or step fault. As soon as the dislocation was struck, right away they cross-cutted in foot and hanging; not finding the reef there they drove on, then stripped the drift to a width of 20 feet; and yet they could not find the displaced reef till back-stoping was resorted to. Finally, compare the drifts advanced in pre-war days, when the miner was paid and appreciated, with the modern manager's workings. Something needs blotting out; better it would be to totally blot out the present methods. Pardon the split-infinitive. Moral: A miner's mistake may cost the company a few sovereigns, a manager's mistake may cost hundreds.

REEF MINER.

Krugersdorp, September 25.

Percentage of Recovery.

The Editor:

Sir—In your issue of September 1911, I note Mr. Theodore J. Hoover's comment on 'Percentage of Recovery,' giving belated acknowledgment to an excellent article on the same topic by Dr. Rudolf Gahl, of Morenci, Arizona. Mr. Hoover speaks disparagingly of *The Western Chemist and Metallurgist*, in which Dr. Gahl was pleased to present his ideas, calling it a "backwoods" magazine.

So far from being a "backwoods" magazine, it was the journal of a live and ambitious society of chemists and metallurgists in the western part of the United States, and Dr. Gahl's contribution to it was typical of the earnest and able support which it received for six years. It was known to the other metallurgical societies of the world, and the articles contributed to it were frequently re-printed by the leading technical journals.

But if Mr. Hoover never knew of the existence of *The Western Chemist and Metallurgist*, he probably does not now know that it is no more, and that he spoke disrespectfully of the departed. Neither does he know that the six volumes of the journal undoubtedly contain other excellent articles of which he might well be apprised.

Denver is not in the backwoods, and the metallurgists who regard it as their professional centre are keenly alive and aware of what is going on. Hence, it was with some degree of surprise that many of us saw Mr. Hoover's original article appear two years after a similar article had been published by us and re-printed in other places. The *Journal* of the Chemical, Metallurgical and Mining Society of South Africa gave extensive notice to Dr. Gahl's article in its issue for November 1909, as also did *Electrochemical and Metallurgical Industry* in July 1909.

We are within that circle of those who, as Mr. Hoover says, "knew all about it a long time ago." Apparently "backwoods" is a relative term, and the timber may grow most densely in the world's greatest centre of population. One is entitled to wonder where Mr. Hoover has been, and to suggest that many good things come out of regions which to him are "backwoods," but which in reality are on the frontier of knowledge and progress. He has opened himself to criticism by this futile attempt to cover his embarrassment by a slurring reference instead of a frank acknowledgment.

H. C. PARMELEE.

Denver, October 9.

[Mr. Parmelee is quite right in sending this protest, but we think there are mitigating circumstances. As far as Mr. Hoover is concerned personally, we may say that, though *The Western Chemist and Metallurgist* was an excellent paper, it had little circulation in this country. As far as we are ourselves concerned, Mr. Gahl's article was published before *The Mining Magazine* was in existence, and for some time afterward we did not see our Denver contemporary; otherwise the specialists who attend to our 'Précis of Technology' would certainly have done full justice to Mr. Gahl. The American Press seems to have been equally ignorant of Mr. Gahl's contribution, for Mr. Hoover's original article on the subject was published, as a novelty, in the *Engineering and Mining Journal* of June 11, 1910. This we abstracted in our 'Précis of Technology' in our issue of July 1910, and accompanied it by editorial comment. At our request, Mr. Hoover elaborated the applications of the formulas in an article appearing in our succeeding issue, and since then we have had numerous contributions from appreciative readers who have been able to give amplifications

of the idea drawn from their own experience. In any case, however, Mr. Gahl cannot claim absolute priority, for, as we recorded in our issue of October 1910, the first printed evidence of the use of these formulas was provided by Mr. J. M. Callow in the catalogue of the General Engineering Co. of Salt Lake City, published in the year 1907.—EDITOR.]

Buying Prospects.

The Editor:

Sir—Your editorial on 'Buying Prospects,' in the September issue, recalls what has often occurred to me regarding the saving that would result if it were possible to form a Clearing House of information about the world's mines and districts. It outrages one's sense of economy to see engineer after engineer wasting time and money in running over the same old holes in the ground, each one not aware, perhaps, that he has had many predecessors.

Such an idea might prove feasible if it were taken up by a well-established engineering firm, as a branch of its business. Such a central bureau might make arrangements with scattered syndicates and practicing engineers to forward to it such information as they were free to send regarding their territory. Or, upon inquiry from a client of this bureau for information regarding a certain property or company, the bureau could send out to its associates asking them if they had first-hand data on this particular subject. The names of such syndicates and engineers that had replied in the affirmative could then be given to the bureau's client for his choice as to whose data he cared to call for. A scale of modest fees could be established.

However, there are some drawbacks and fine points to such a scheme. As far as exploration syndicates who have obtained their information at their own cost are concerned, there would appear to be no objection to the idea, from their standpoint; of course, in the case of an engineer, his information, for the most part, belongs to those who have paid for it. How is it from the mine-owner's standpoint? His mine is his secret, and it is to his advantage that many engineers come to look at it, with the hope that one may finally see more in it than the others did; besides he may have done more development work. In reply it might be asked, what is the difference in paying a fee for existing information and paying for similar information obtained anew? And it could also be maintained that such existing information might help the mine-owner, for, while perhaps the mine is not what a certain crowd is looking for, it might be just the kind of a proposition that would suit another. Another drawback to the general acceptance of this clearing house idea has to do with personality. In all professions the personal equation enters largely, and is, as a rule, the cause of the engineer being retained; it is *his* personal opinion that is wanted.

W. N. CUMMINGS.

Tucson, Arizona, October 14.

Pyrites Deposits of Huelva.

The Editor:

Sir—Mr. H. F. Collins' article on 'The Pyrites Deposits of Huelva,' which appeared in your August issue, is of particular interest to students of these deposits, more especially as it has been written by one with considerable experience of the orebodies throughout that region. If others could be induced or permitted similarly to record the results of their extended observations we should gain much.

It is doubtful whether the secondary enrichment of the deposits has been discussed to the extent that Mr. Collins suggests. It seems to me that that phase of the subject has received far too little serious attention. It is also questionable whether his substitution of 'surface' for 'secondary' enrichment is altogether a happy thought. Does not 'surface' enrichment, as a general term, connote 'gossan' enrichment, as distinct from the sulphide enrichment beneath the gossan?

The writer's description of banded and complex ores, and of variation in composition, is valuable, but it appears to me that he lays undue stress on the assumed abnormality of the larger orebodies. While great variations, both in structure and composition, are admitted, and must impress themselves on those who have to do with the sampling and shipment of the ore, I think, nevertheless, that the geologist is fully justified in regarding the Huelva deposits in general as low-grade lenticular pyritic masses, any notable variation in composition being a departure from the normal type. It is natural that these mineralogical variations should assert themselves most strikingly in the smaller orebodies, since the physical and chemical conditions of deposition would be most readily disturbed, with resulting irregularities in composition, where the zone of ore deposition was restricted in size, and the ore-bearing solutions consequently restricted in their action and more sensitive to disturbing influences.

Mr. Collins' contention that there has been

a secondary deep-seated enrichment by chalcopyrite, accompanying the intrusion of the basic dikes, is an important one. If it is upheld by future research, it will explain some peculiar mineralogical features. My own observations* led me to the conclusion that the basic dikes had immediately preceded the primary deposition of the ore, and this view was supported by petrographical work at Esperanza, which Mr. Collins cites as an instance in support of his view. At all events, his suggestion of a Tertiary age for the basic intrusives is bold, and is unsupported as yet by any authoritative work on the field-relations of these intrusives throughout the area. It is doubtful if the point will be cleared up without a good deal of petrographical work, at Huelva, and in the adjoining areas to the north and northeast.

These are surely scientific issues, but they are of sufficient interest to economic geologists to permit of their being pointed out here, and there are many who would welcome a more extended discussion of these points by Mr. Collins, as well as by others on the spot.

A. M. FINLAYSON.

Maymyo, Upper Burma.
September 24.

Statements of Cost.

Sir—The American custom of referring to the cost of copper production as 6, 9, 12 or any other number of cents per pound appears not to be well understood on this side of the water, if my experience is a general one. Here it is often taken to be an expression of the level of operating cost apart from anything else, and the inference appears to be that a company that produces copper at 8 cents per lb. must necessarily be working at much lower cost than one which produces at 12 cents. As a matter of fact the expression is a function of two things, namely, the metal production per ton of ore and its cost, and herein has its value.

Some copper mines at Ely, for instance, produce copper at about 8 c. per lb. and as the production is about 20 lb. per ton the total cost per ton of ore is only $1·60. If a mine in a locality in which costs were $10 per ton were producing copper at 8 c. per lb., its yield would have to be 125 lb. per ton. If the production dropped to 83 lb. per ton it would increase the cost to 12 c. per lb. A cost of 8 cents per ton is therefore possible on the widely varying yields of 20 and 125 lb. copper, respectively. It would be wrong to assume from this that a copper ore yielding 20 lb. of metal per ton can always be profitably worked.

The value of the expression is only one indicative of the margin of profit available in the selling price of the metal. We must know the original content per ton, the practicable percentage of extraction, and the cost of production before it can be made to mean anything more than this.

My real reason for touching upon this subject, however, is to ask why, if this method of speaking of copper production be a good one, it should not be applied to the ounce of silver, using the same reservations. If we know that a company can only produce silver at a cost of 2s. 6d. per ounce we know it is an unprofitable concern, provided of course it produces only silver. If on the other hand we are told that it produces silver at 8 or 10 or 18 pence we can at once get some idea of its profit-earning capabilities. In Mexico, for instance, we read the statement that a certain company is handling 560-gramme silver ore but is making no profits, while another company on 450-gramme ore is doing well. The value of silver expressed in grammes conveys no very clear idea to the English reader and there is undoubtedly a good deal of confusion on this point. But most people know that the present price of silver is in the neighbourhood of 2s. per oz. and if the ounce of silver were treated in the same way as the pound of copper there would be a complete understanding on at least one important point.

G. A. DENNY.

London, October 30.

Malaria.

The Editor:

Sir — Mr. Stephen Lett's letter in your October issue is particularly interesting to me as I have often mentioned to friends the great relief that I also discovered accidentally, some years ago, when travelling in South America during a particularly bad mosquito season. Having none of the acknowledged specifics at hand, I, in despair, tried the effect of ordinary 'Odol,' with most beneficial results.

I do not write the above as an advertisement for 'Odol,' but only in case other readers of your magazine may find themselves in similar predicaments.

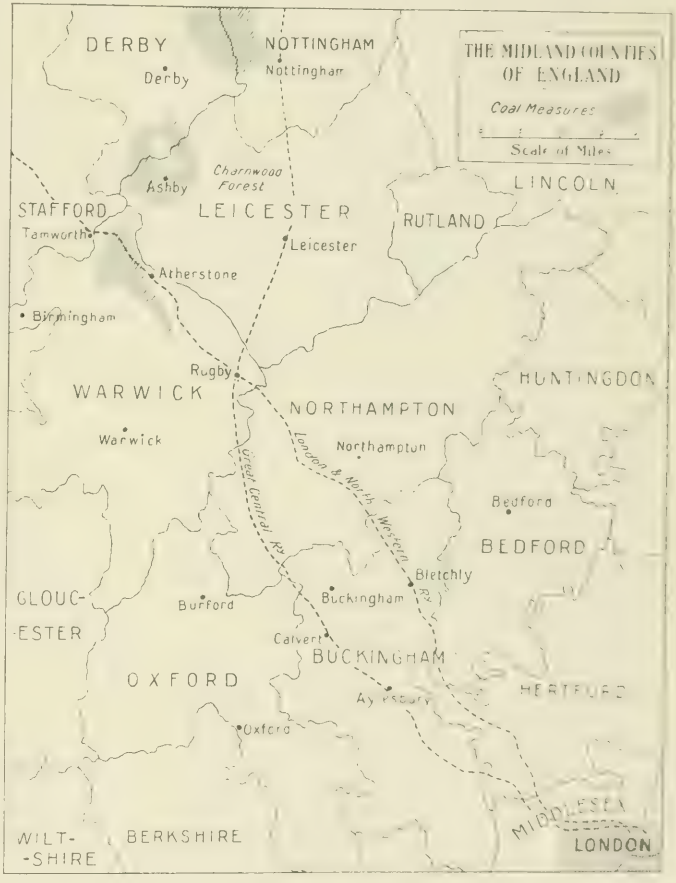
NOËL G. HACKNEY.

London, October 21.

* *Economic Geology*. Vol. V, 1910, pp. 357–406.

PRÉCIS OF TECHNOLOGY

Boring for Coal in Buckinghamshire.—Some interest has been aroused by the news that prospecting for coal is being conducted by means of bore-holes in Buckinghamshire, in the neighbourhood of Calvert on the Great Central Railway. An article on the subject appeared in the *Colliery Guardian* for October 20, in which a plain unbiassed statement of the geological possibilities is given, with a view to counteract some of the erratic paragraphs that have appeared in the daily papers. Coal is not at present worked in any Midland county nearer to London than Warwick and Leicester, and the number of collieries there are not so numerous as in Nottingham, Stafford and Derby farther to the northwest. In the Buckingham district only two bore-holes have been sunk, one at Burford in Oxfordshire, 30 miles southwest of Calvert, and the other at Bletchly, twelve miles east of Calvert. The Burford boring cut the coal measures at 1202 ft.', and that at Bletchly, after passing through the oolite, encountered granite boulders. The problem of the possible occurrence of the coal measures in the neighbourhood of the Charnian axis has always troubled geologists. This axis is a line (N.W. and S.E.) of upheaval and folding most prominent in the Charnwood Forest district of Leicestershire, where Pre-cambrian rocks and granite and greenstone come to the surface. It marks a buried mountain range dating from before the Trias. It is generally held that coal measures may be found in the folds of these subterranean ranges. P. F. Kendall offered evidence on this subject before the last Royal Commission on Coal Supplies. It is stated that boring at Calvert was undertaken because of the discovery of a natural gas similar to fire-damp. One favourable circumstance is that the secondary strata in the district are not thick, so that if any coal is to be found, it should be cut at a depth of not more than 1000 ft.



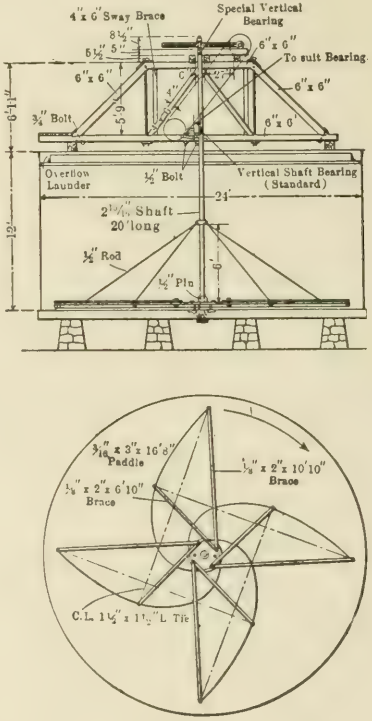
Wire Ropes for Mining Purposes.—At the October meeting of the Mining Institute of Scotland, Dugald Baird, of the Lugar Ironworks, Ayrshire, read a paper on wire ropes as applied to mining; this was full of practical hints to those in charge of hoisting and hauling operations. He began by comparing various qualities of iron and steel wire used in the manufacture of ropes, and discussed the methods of testing them, and afterwards proceeded to make suggestions as to the design of the winding-engines, drums, pulley-wheels, keps or supports for the cage at surface, so as to ensure the best results from the ropes. He made a number of suggestions as follow: (*1*) The winding drum should be at a sufficient distance from the shaft to prevent side-wear of the rope. (*2*) The drum should be so wide that the rope will occupy only one course. (*3*) The diameter of the drum and pulley-wheels should not be less than a hundred times the diameter of the rope, and a thousand times the diameter of the thickest individual wire in the rope. (*4*) A rope lasts longer if there are no keps at the surface, and if, when the cage is at the bottom, no slack is allowed. (*5*) The pulley-wheels should be designed with such dimensions that they do not remain stationary for a time after the rope is let out or continue to revolve after the cage comes to the surface; this problem has not yet been solved. (*6*) Ropes should be made with Lang's lay, unless locked-coil or other special designs are used. (*7*) When the drums are lagged with wood it is advisable to have a helical groove so that the rope will not rub on itself as it is wound and unwound. The pitch of the groove should be such that a space of $\frac{3}{32}$ in. is left between each coil. This arrangement is specially necessary when the drum is close to the pit, for under this condition the rope will otherwise mount on itself. (*8*) The individual wires of the rope should be as large as possible consistent with item (*3*). (*9*) It is best to galvanize the ropes, except in such circumstances where a thick preservative coat of paint can be put on; but such a coat has a disadvantage because it prevents examination. (*10*) The effective life of a rope is difficult to judge, but it is certain that a rope should be used for only a limited period; $1\frac{1}{2}$ to 7 years are the minimum and maximum in the experience of the writer, and he is of opinion that a galvanized rope may be safely used half as long again as a bright-wire rope. (*11*) Ropes used in sinking should be of the non-rotating type. These are constructed

of two concentric layers laid in opposite directions. Such ropes are not particularly necessary for ordinary winding. Flat ropes are sometimes used, consisting of six or eight small ropes stitched together with bessemer wire. Their advantage is that they give an ideal scroll-drum movement, and thus engines of smaller size can do the same work as the larger engines do with a parallel drum. They are, however, more expensive, and they give trouble by splitting apart; their life is not so great as the ordinary rope. The author suggested two subjects for discussion. One was whether the rope coming off the top of the winding drum or that coming off the under side has the longer life. The general opinion is in favour of the former case, as both the bends it makes are in the same direction, but the author's experience is that there is little difference. The second point was whether a rope lasts longer when the drum is lagged with wood or when the rope rests direct on the metal. It is usually supposed that the advantage is with the wooden surface, but the author considers that experience ought to be recorded in this connection.

Metallurgy at Globe & Phœnix.—In our July issue, H. T. Brett contributed an article on metallurgical practice at the Globe & Phœnix gold mine in Rhodesia and recorded that, though the treatment by amalgamation in the stamps, the extraction from concentrate, and the handling of slime after weathering were giving good results, the antimony in the ore militated against the success of cyanide treatment of the sand-tailing. He mentioned that probably this part of the plant would have to be abandoned and roasting and sliming adopted. The *Rhodesian Mining Review* for September 6 describes the new plant now being erected. The capacity will be 300 tons per day, 100 tons being current sand, and 200 tons accumulated sand of which there is more than 100,000 tons. There are three Edwards roasting furnaces, and special grates have been designed so as to make it possible to use Wankie coal. The steel chimney is 140 ft. high and 7 ft. diam. The roasted ore on discharge will be mixed with cyanide solution and elevated by a tailing pump to a classifier. The underflow will be treated in 12 grinding pans placed in circuit and the discharge returned to the tailing pump. The overflow of the classifier will go to 2 tube-mills, each 22 by 5½ ft., the feed-cones of which are arranged so that the final discharge shall be *minus* 200. The slime will go to a Dorr thickener and thence to 8 agitator-vats 20 ft. high by 8 ft. diameter. The time occupied in agitation will be 12 hours. The resulting gold-bearing solution will be removed by continuous decantation in Dorr thickeners. The Merrill zinc-dust precipitation process will probably be adopted. It will be seen that the plant is to contain the latest ideas in gold metallurgy.

Treating Copper-Lead Matte.—In *Metallurgie* for June, R. Hesse describes a new method of treating leady copper matte, particularly in connection with this product coming from the Otavi company's mine in German Southwest Africa. The Otavi matte averages 40% copper, 24% lead, and 11% iron. The method is to roast it to 4% sulphur and fuse with silica; the result is the production of copper containing a small amount of lead, while the rest of the lead and the iron go into the slag. The copper is refined, and the lead slag so produced is sent to the lead-smelting furnace, along with the slag produced in the first reaction.

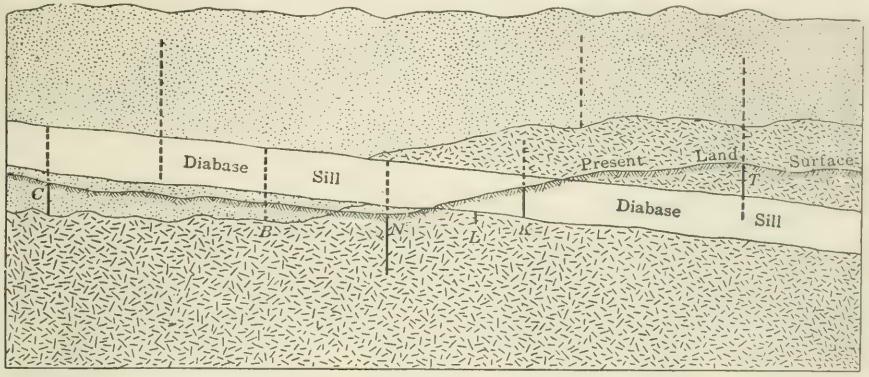
Forbes' Slime Thickener.—In the *Engineering and Mining Journal* for October 7, D. L. H. Forbes describes his slime thickener in use at the El Tigre cyanide plant at Ysabal, Sonora, Mexico. This machine is a variation of that invented by J. N. V. Dorr, but the revolving rakes are discarded for the spiral paddles shown in the accompanying illustration, and it is claimed that by this arrangement the settled slime is moved to the centre more evenly and without eddies. Two of these machines have been at work for over a year, for the purpose of removing the gold-bearing solution after cyanidation in Pachuca vats. There are four spiral paddles arranged as shown, of such design that the blades are at 45° to the radius. These revolve once in 5 minutes, and the power for each machine is ¼ hp. From 100 to 130 tons dry are treated per machine per day. The pulp enters at the dilution



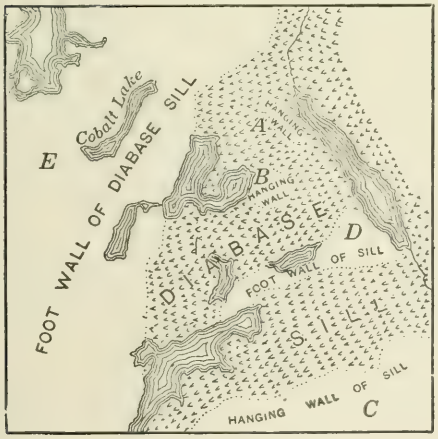
of 1 part solid to 2 or 2½ parts solution by weight, and the discharge is 1 : 1½. The material treated is a mixture of natural clay slime and tube-mill product, and 85 to 90% will pass 200 mesh. The clay forms about one third of the mixture, and it is particularly difficult to settle.

Geology of Cobalt.—We have already on several occasions described the geology and the ore deposits of the Cobalt area, Ontario, Canada; nevertheless, it is opportune to quote an article appearing in the *Engineering and Mining Journal* for September 30 by Willet G. Miller, the Provincial Geologist of Ontario. Mr. Miller was the first geologist to write a report on the district, eight years ago. He and his staff have recently made another complete examination, and an official bulletin will be issued shortly. The article now referred to is an outline of the matter contained in this bulletin. The basement rocks of the district belong to the Keewatin series of basic volcanic types usually known as green stones or green schists, together with dike rocks and some sedimentaries. These rocks at one time formed the surface of the land, and

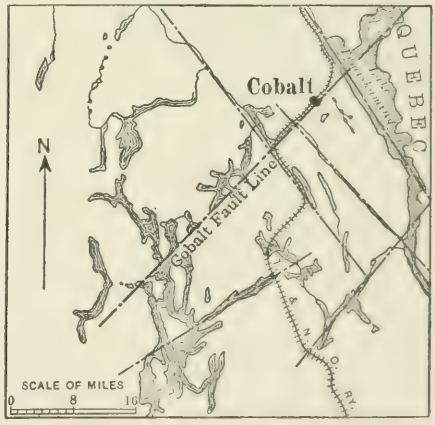
they were afterward eroded into hills and hollows, and covered with conglomerates and other fragmental rocks of the Huronian period. Subsequently a quartz-diabase sill was intruded through both the Keewatin and Huronian, having a thickness of 500 ft., and a dip of 17° toward the south or southeast. The accompanying generalized vertical section shows how the land surface has since then been removed, leaving little of the Keewatin hanging wall. The map shows two or three isolated remnants of the hanging wall



GENERALIZED VERTICAL SECTION OF COBALT DEPOSITS.



Geological Map of Cobalt.



Faulting Lines at Cobalt.

resting on the diabase. Of these (*A*) is on the Nova Scotia property and (*B*) is on the Colonial. In the main part of the hanging wall (*C*) are the Temiskaming and Beaver veins. At (*D*) and (*E*) the sill has been eroded and has exposed the foot-wall. In the vertical section (*T*) represents the Temiskaming vein in the wall above the sill; (*C*) is a type of vein in the Huronian; (*N*) a type of vein in the Keewatin below the sill, such as No. 26 on the Nipissing; and (*K*) is a type of vein in the sill itself, such as No. 3 on Kerr Lake. Nearly 90% of the ore so far produced has come from veins on the foot-wall of the sill, a fact chiefly due to so large a part of the overlying rocks having been removed. Mr. Miller does not commit himself definitely to a theory of the formation of the mineral veins, but gives the view generally held that they have been formed by magmatic water, introduced at the same time as the sill, and working upward and downward through the cracks on the sill and the rocks above and below. He is of opinion that meteoric water, that is, water working downward from the surface, played an important part also, at least as regards some of the ores. He considers that the diabase sill was subjected to the action of both magmatic and meteoric water, and that minerals were thus extracted to be re-deposited elsewhere; also that some of the minerals now in the veins may have been dissolved out of the wall rocks. The cobalt-nickel ores are generally of greater age than those of silver, so it is possible that the magmatic water played the more important part in their deposition, and that the meteoric water were largely instrumental in the deposition of the silver. He does not consider that secondary enrichment is a feature worth as much consideration as other geologists have given to it. As regards faulting, he shows that faults with small displacements are numerous, and that they extend in point of time from the Keewatin to the Glacial period. The most important fault so far examined has a throw of 300 to 400 ft. and is approximately parallel to the

main La Rose vein. The faults may be classified into two systems of weakness, one northwest and southeast and the other northeast and southwest. The former is the more striking, as it is in the direction followed by the Ottawa and the Montreal rivers. The author refers to a recent discovery of mercury ore at the Nipissing, but no exact information is yet to hand.

Smelter Gases.—In the *Mining and Scientific Press* for September 23, Stewart W. Young describes his ' thiogen ' process for treating sulphurous acid gas and reducing it to sulphur, that is being tested at San Francisco with a view to its application to the neutralization of smelter gases. The reaction on which it is based is that between a hydrocarbon and sulphurous acid, whereby sulphur is liberated and carbonic oxide and water formed. This reaction requires a high temperature, and the evolution of carbonic oxide is another drawback. Mr. Young has, however, elaborated a modified process by means of which a lower temperature is possible and the effluent gases consist of nothing but carbonic acid and water. The sulphurous acid is passed through calcium sulphide, with the production of calcium sulphite and free sulphur. After the removal of the latter the sulphite is heated with a hydrocarbon and reduced again to sulphide, which is returned for re-use, and carbonic acid and water formed. The process has yet to be tested on a practical scale and its cost ascertained, but it is of considerable interest and may serve, in spite of its cost, to settle the much-vexed question of smelter smoke.

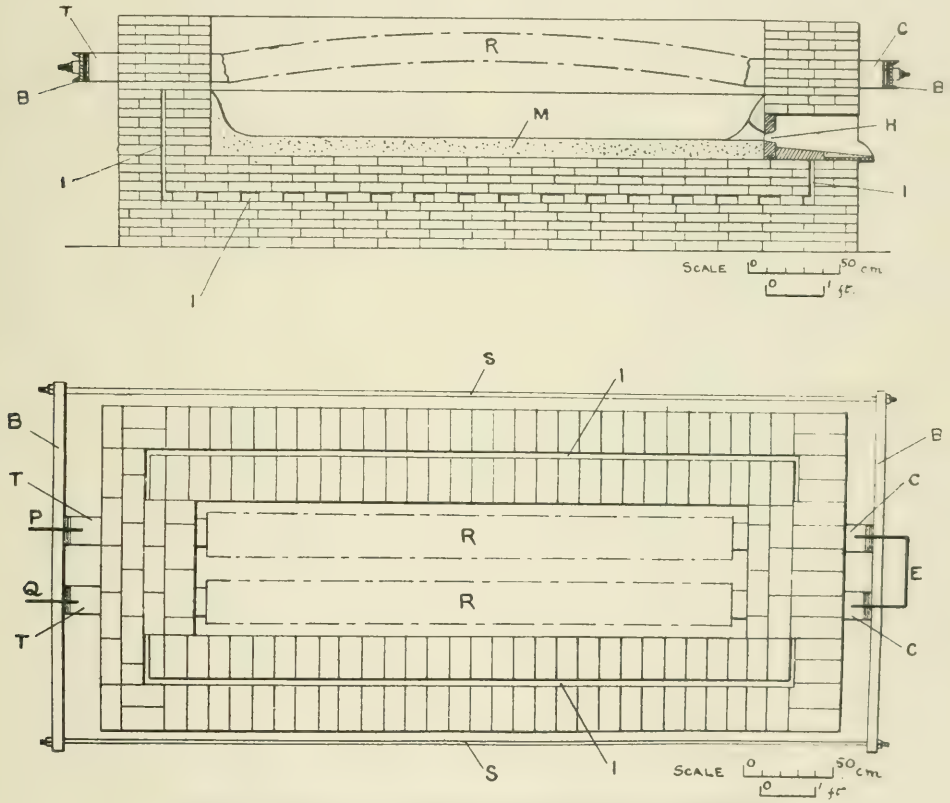
The Economics of Tube-Milling.—At the October meeting of the Institution of Mining and Metallurgy a paper on this subject by H. Standish Ball was submitted. The paper was the thesis for the science degree at McGill University, at which the writer was studying as Research Scholar of the Transvaal Chamber of Mines. The paper is a lengthy one and may be divided into two parts, the first being a general resume of the history and applications of the tube-mill and the theories of rock-crushing, and the other a record of experimental investigations undertaken by the author. The first series of tests were made with a view of ascertaining the best rate of feed, the rate of revolution (41), the percentage of moisture (38%), and the pebble load (1200 lb.) being constant, the inside dimensions of the mill being 3½ ft. length and 2 ft. 10 in. diameter, and the lining being silex brick set in cement. The feed was sand approximately 18 mesh, and the discharge was analysed for minus 120 mesh. Six tests were made with feeds varying from 7·2 tons to 23 tons per 24 hours. It was found that the test at the rate of 18·6 tons gave the highest mechanical efficiency and the highest crushing efficiency. The author examines the results by means of diagrams. The second series of tests was made with a view of ascertaining the best proportion of moisture. The feed was constant at 12·6 tons per 24 hours and the pebble load and the number of revolutions the same as before. The result was that 37·7% of moisture (presumably by weight) was the most efficient from the point of view of power used for the production of equal quantities of minus 120 material. This figure agrees fairly well with the 38·4% of Walter Neal in the *Mining and Scientific Press* for April 2, 1910, and the 38·5% found by G. O. Smart in his paper on the Caldecott cone read before the Chemical, Metallurgical, and Mining Society of South Africa on May 10, 1910. A third series of tests was made with regard to the pebble load, and the conclusion was that 1050 lb., equal to $\frac{7}{16}$ ths of the internal volume, was the best. A fourth series was undertaken in order to find the most efficient speed of revolution ; the feed was 7·2 tons per 24 hours, the pebble load 1200 lb., and the moisture 38%. The revolutions per minute varied from 33 to 46, and it was found that both the mechanical and the crushing efficiencies were greatest when the rate was 37 per minute. Mr. Ball quotes the view of J. W. Bell, his professor, to the effect that the most efficient percentage of moisture coincides with the percentage of voids. Mr. Bell has already discussed this matter in our pages, and it has been pointed out that there is a fallacy here, because in the tube-mill tests the percentage is by weight and in the calculation of voids the comparison is by volume. Mr. Ball's paper will prove of value and will be closely read by all interested in tube-mill practice.

Lapland Iron Ores.—At the October meeting of the Iron and Steel Institute, L. Leigh Fermor, of the Indian Geological Survey, presented a paper written for the purpose of traversing W. H. Herdsman's paper, read at the May meeting, on the origin of the iron ore deposits in Swedish Lapland. Mr. Herdsman had brought forward a theory that these deposits are metamorphosed sedimentaries of the Cambrian or Silurian age, and his chief argument was that this theory accounts for the presence of phosphorus. Mr. Fermor shows that Mr. Herdsman is at variance with Continental and American geologists, and, in order that a succinct account shall appear in England written by an English geologist, he reviews the opinions of these geologists and points out Mr. Herdsman's fallacies. O. Stutzer, a Norwegian investigator, had contributed an elaborate paper to the Iron and Steel Institute in 1907 on the geology and origin of these ores, and it was in fact his paper that Mr. Herdsman attacked. Per Geijer has also written an elaborate monograph on the same subject in the Swedish language. Mr. Fermor gives an account of his visit to these deposits at the time of the Stockholm geological congress, and of the discussions with the many other eminent authorities who were present on the same occasion. In his opinion the evidence irresistibly points to the conclusion that the iron ore deposits and associated porphyries have been produced by magmatic differentiation from syenitic magmas. Sometimes the magnetite-apatite rocks have segregated practically in situ in the syenitic rocks ; at other times they have segregated from the syenitic magma at a lower level, and have been erupted separately from the syenitic rocks ; and sometimes subsequent metamorphism has imparted a parallel structure to both the orebodies and the enclosing syenitic rocks.

Electric Smelting of Zinc Ores.—In our last issue we gave a lengthy abstract of reports on the electric furnace at Trollhattan, used for smelting complex zinc-lead sulphides. Our figures taken from J. C. Moulden's report on the probable results of treating concentrated slime from the Central mine at Broken Hill, owned by the Sulphide Corporation, were incorrect, the error being due to Mr. Moulden including the cost of roasting the slime in both the cost of material and the cost of treatment. The correct figures are as follow : Cost of ore per metric ton at Trollhattan £5. 0s. 4d., value of recoverable metal, £9. 9s. 11d., cost of treatment £3. 0s. 7d., profit £1. 9s. The material is figured as containing 32% zinc, 23% lead, and 25 oz. silver ; the recovery is estimated at 75% zinc, 80% lead, and 80% silver ; and the price of metals is taken at £22 zinc, £12 lead, and 26d. silver. The error in our figures is found in the total cost at the smelter which was given at £5. 8s 5d. instead of £5. 0s. 4d., the difference being the cost of roasting ; otherwise, the figures for the value of the recovered

metals £9. 9s. 11d., the cost of treatment £3. 0s. 7d., and the margin of profit £1. 9s., were given correctly.

Imbert-Fitzgerald Zinc Process.—In a recent issue we noted in our column 'Current Literature' a paper read at the Fiftieth Anniversary Congress of the Massachusetts Institute of Technology, by F. A. J. Fitzgerald, of Niagara Falls, describing his electric furnace that is at work at the Hohenlohe Hutte, Germany, for treating zinc ores by the Imbert reaction. We are given to understand that this process is at present interesting people connected with Broken Hill, and that



FIRST FORM OF THE IMBERT-FITZGERALD ZINC FURNACE.

something may be heard of it before long in London financial circles, so we return to the subject again and give an illustrated abstract of Mr. Fitzgerald's paper. The Imbert process is a modification of the well-known reaction whereby metallic iron will release the zinc and lead of blende and galena, and combine with the sulphur. He makes the reaction take place in a bath consisting of a mixture of oxide and sulphide of iron. The zinc is volatilized, and the lead and silver fall to the bottom of the furnace, the other two products being slag formed from the gangue, and an iron matte containing the sulphur. This matte can be partly roasted and used again. It will be seen that reduction to metal is not effected by carbon, as is usual in zinc furnaces, and that no preliminary roasting has to be done. Heat is required to bring the charge to the temperature at which the reaction takes place, about 1400°C. Imbert's difficulty was to devise a suitable furnace. In the furnace designed by Mr. Fitzgerald, the heat is generated electrically by the resistance of arches (*R*), built up of interlocking plates of carbon In the accompanying illustrations, the cover of the furnace is not shown ; it contains feed-pipes, and pipes for the escape and collection of the zinc vapour. The current enters at (*P*), passes along one resistor (*R*), back by way of the conductor (*E*) to the other resistor, and out at (*Q*). The power absorbed by the furnace is 150 kilowatts. Mr. Fitzgerald does not say anything of the capacity of the furnace or of the results achieved, but no doubt this information will be given shortly. One advantage possessed by this furnace over others recently proposed for the treatment of zinc-lead slime is that, as roasting is eliminated, the loss of silver by volatilization will be obviated.

Since writing the above, we have received another paper by Mr. Fitzgerald, read before the American Electrochemical Society on September 21. In this communication, he shows that the heat losses with this type of resistor were so great that its position and structure have had to be modified. We have also seen the specification of United States patent 994,217 granted to Mr. Fitzgerald's co-worker, John Thomson, in which the resistor is placed in a sealed box immersed in the bath itself. This arrangement would obviate the dissipation of the heat radiated from the top of the arch, that was the cause of the abandonment of the form of furnace as illustrated.

Zinc Extraction by Bisulphite Process.—*The Mining Journal* (London) for October 21 contains an article professing to describe the bisulphite process for the treatment of complex and intimately-mixed sulphide ores containing zinc. The article is a long one, but the information afforded is meagre, and quite valueless to the metallurgist who is desirous of appraising its practical value. As the process is being tried on Mount Read and other zinc-lead-pyrite ores found in Tasmania, we make this brief reference to what may be considered the official statement. The process is associated with the names of Sulman & Picard, Hommel, and Fradd, though we believe that the first-named have no connection with it nowadays. The article states that the ore is crushed and roasted in the usual way, and the sulphurous acid gas passed through pulp consisting of roasted ore and water. In this way the soluble bisulphite, $Zn H_2 (SO_3)_2$, is formed. The resulting solution is taken to vats where insoluble monosulphite, $Zn SO_3$, is precipitated. This monosulphite when heated is dissociated into zinc oxide and sulphurous acid. The zinc oxide is free from lead and is a desirable raw material for the zinc distiller. The remaining pulp, after the removal of the bisulphite, can be treated for lead or copper in any ordinary way according to its composition.

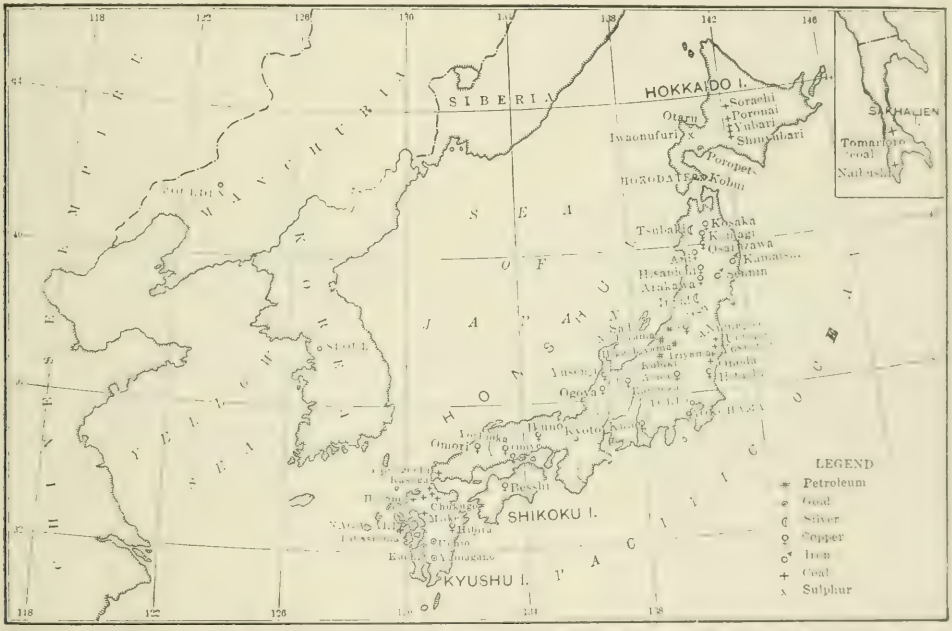
The Standard Tin Contract.— Elsewhere in this issue we refer to the new basis of contract for the sale of metallic tin, adopted by the London Metal Exchange. In the report issued in connection with it, the following analyses were published:

	Tin %	Antimony %	Arsenic %	Lead %	Bismuth %	Copper %	Iron %	Silver %	Sulphur %
Banka	99·950	0·007	nil	trace	nil	0·018	0·015	nil	trace
Billiton	99·960	000·6	nil	nil	nil	0·023	nil	nil	nil
Penang	99·939	trace	0·013	trace	nil	0·016	0·028	nil	0·004
Singapore	99·870	0·008	0·045	0·034	0·003	0·352	0·003	0·006	0·005
Mt. Bischoff	99·795	0·015	0·063	0·037	0·005	0·035	0·042	trace	0·008
Pyrmont	99·938	0·017	0·019	trace	nil	0·022	trace	nil	0·004
Irvinebank	99·580	0·062	0·034	0·221	0·025	0·126	0·002	0·018	0·004
Williams-Harvey (1)	99·860	0·015	0·040	0·004	0·005	0·047	0·003	nil	0·006
Williams-Harvey (2)	99·560	0·166	0·037	0·162	0·007	0·500	0·005	trace	0·013
Williams-Harvey (2a)	99·350	0·245	0·065	0·223	0·015	0·042	0·016	trace	0·013
Williams-Harvey (3)	99·200	0·300	0·037	0·396	0·007	0·100	0·013	0·014	0·006
Williams-Harvey (4)	99·641	0·011	0·022	trace	0·001	0·020	trace	trace	0·005
Penpoll (1)	99·720	0·118	0·054	0·041	0·007	0·052	0·004	0·009	0·007
Penpoll (2)	98·710	0·569	0·042	0·546	0·055	0·103	0·007	0·015	0·004
Penpoll (3)	99·300	0·325	0·056	0·212	0·050	0·088	0·002	0·021	0·009
Redruth	99·160	0·176	0·053	0·177	0·017	0·445	0·014	0·006	0·008
Goldschmidt (1)	99·860	0·004	nil	0·102	nil	0·043	trace	nil	trace
Goldschmidt (2)	99·460	0·015	nil	0·425	nil	0·069	trace	nil	trace
Goldschmidt (3)	99·150	0·122	0·046	0·143	0·112	0·352	0·007	0·006	trace
Chinese (1)	99·343	0·031	0·040	0·434	0·007	0·052	0·010	trace	0·011
Wing Hong (2)	98·662	0·039	0·035	1·035	0·012	0·134	0·014	trace	0·011
Wing Hong (3)	95·280	0·381	0·050	3·895	0·020	0·106	0·026	0·018	0·008

Refining Gold and Silver Bullion.—The October *Bulletin* of the American Institute of Mining Engineers contains a lengthy and detailed paper by Edward B. Durham on the electrolytic methods of refining gold and silver bullion used at the United States mint at San Francisco. The outline is as follows: The silver bullion is refined in an electrolytic bath consisting of an aqueous solution containing 3% silver as nitrate, from 1½ to 2½% of free nitric acid, and a little glue. The current density is 8·3 amperes per square foot of cathode surface, and the voltage of the entering current is 15. All the metals but silver and lead go into solution and these are precipitated as chloride, while the copper accumulates in the electrolyte which eventually has to be renewed. The gold is chiefly deposited on the cathodes, but some is precipitated and becomes mixed with the chlorides. The chloride residue is washed in hot water for the removal of the lead, and treated with granulated zinc and sulphuric acid for the recovery of the silver as metal, which with the precipitated gold is sent back to the refining cells. The spent electrolytes from the gold and silver cells, and the various wash waters go to vats containing scrap iron, where the copper and lead are precipitated. The precipitate is refined in a sulphate electrolyte. Any metals of the platinum group in the bullion are recovered here.

The Ashio Copper Mine, Japan.—The *Mining and Scientific Press* for October 14 contains a lengthy and highly interesting account of the Ashio copper mine, written by Thomas T. Read, who made a personal inspection in 1910. This mine is the largest producer of copper in Japan, and is followed closely by the Besshi and Kosaka, the outputs for 1910 being respectively 7049, 6629 and 6286 long tons. The position of these mines is shown on the accompanying map. The Ashio mine belongs to the Furukawa company, a private corporation that owns fifteen copper mines, three silver mines, and seven coal mines. It was discovered in 1608, but its active development dates from 1877 when it was acquired by the present owners. Its success was the foundation of a fortune, and enabled the Furukawa family to purchase and develop nearly all the important copper and silver properties in the northeastern part of Hondo island. The mine is 100 miles north-northwest of Tokio, and 15 miles southwest of Nikko, a little town noted for its magnificent temples and tombs. Close by are also the lake Chusen-ji, a favourite watering place, and the hydro-electric power-house at Hosoö. The mountain containing the mine is a volcanic plug or neck of liparite, upthrust through paleozoic sediments, mostly clay-slate, sandstone, and quartzite. This is cut by innumerable almost vertical veins, belonging to two distinct series. The veins pass into the surrounding sediments, but quickly disappear, the structure forming an excellent example of fissuring during cooling and subsequent vein-filling by the waters of dying vulcanism. The order of vein-filling is as follows: (*1*) quartz, (*2*) chalcopyrite associated with some pyrite, (*3*) pyrite, sphalerite, and galena, and (*4*) quartz. The chalcopyrite carries about 2 oz. silver and a few grains of gold, and the galena and sphalerite contain several ounces of silver. Many other copper minerals

are found in small quantities, as also are pyrrhotite and arsenopyrite. The veins are narrow and the ground faulted. In spite of these natural drawbacks, the work is efficiently and cheaply done on a well-devised contract system. Three eight-hour shifts are customary below ground, and two on the surface. Access to the deposits is gained by three adits, the entries being about equidistant round the base of the hill. Two of these adits are on the same level and are connected, while the third, the Tsudo, is 450 ft. below them and connected with them by two winzes. Workings extend 1100 ft. above the two upper adits and are mostly exhausted, and for 1400 ft. below, sinking being still continued. There are 10 winzes and 100 miles of workings. Ore-dressing plants have been built at the mouth of each adit, the principal being at Tsudo. The capacity of this mill is 250 tons per day and the combined capacity of the other two is 350 tons. The ore varies from 1½ to 9% copper, averaging 4%. As it comes from the mine, it is dumped on a 80 mm. grizzly ; the oversize is sorted into rich ore, low-grade ore, and waste, the low-grade being afterwards spalled to pass the grizzly ; the undersize is sent to a set of trommels with apertures varying from 3 to 40 mm. The 40 mm. product is sorted into rich ore, low-grade ore, and waste, and the low-grade ore is re-crushed. The finer products are jigged and the coarse middling re-crushed ; the finest products are classified and treated on Overstrom, Wilfleys, Cammett, and Evans tables. In the smelter, which is situated on the northeast side of the hill, blast-furnaces have always been employed, and various kinds of converters have been used since 1893 when the original Manhes type was tried. The average product to be smelted contains 12% copper, 28% iron, 25% sulphur, and 32% silica. The fine material is pot-roasted. The gases from the blast-furnaces are sent through chambers where they are exposed to showers of lime-water ; but in spite of this, the effluent gases do damage to the surrounding hills. Other sources of trouble and expense are the impounding of the tailing and the slag, and the necessity for neutralizing the acid mine-water. The blister copper is sent down the valley to the refinery, a short distance from Nikko. This refinery also treats the products of all the other mines of the Furukawa group.



MINERAL MAP OF JAPAN SHOWING POSITION OF ASHIO COPPER MINE.—From the Engineering Magazine.

CURRENT LITERATURE.

Winding Engine.—*Engineering* for October 27 describes, with full drawings, the 5500 hp. winding engine built by the Sandycroft company for the Champion Reef mine.

Shaft-Sinking in Wet Ground.—At the August meeting of the Chemical, Metallurgical, and Mining Society of South Africa, B. C. Gullachsen described the method of sinking a shaft at the Ferdinand colliery, Silesia, through wet ground.

Timbering Shafts.—In the *Mexican Mining Journal* for October, H. G. Elwes describes a method for timbering shafts, using lighter pieces with better joints, suitable in places where wood is scarce.

Prevention of Overwinding.—The *Iron and Coal Trades Review* for October 13 contains a description of Landale's gear for preventing overwinding used in connection with Corliss engines at a coal mine in Fife.

Water Used in Cyanidation.—In the *Mining and Scientific Press* for September 30, George A. James urges the necessity for carefully examining the quality of the water used in cyanide processes, and shows how natural impurities, both solid and gaseous, act as cyanides or interfere with the extraction.

Natoma Dredges.—In the *Mining and Scientific Press* for October 7, Newton Cleveland describes the new gold-dredges built this year for the Natomas Consolidated, operating alluvial deposits in the Sacramento valley, California

Cyanide Bullion.—In the *Monthly Journal* of the West Australian Chamber of Mines for August, J. Boyd Aarons and Herbert Black describe the method devised by them at the Chaffers mine for producing a higher grade of bullion from the zinc-box precipitate.

Air-Agitation.—In the *Mining and Scientific Press* for September 30, J. W. Swaren gives some interesting reminiscences of the use of air-agitation, before it was applied in the Brown agitator or Pachuca vat for the treatment of slime. He shows that similar vats were used many years ago in several chemical operations, and, as far as gold metallurgy is concerned, E. L. Oliver used them at the North Star mine, Grass Valley, for cyaniding pulp and the electrodeposition of the dissolved gold.

Huntington Mills.—The October *Bulletin* of the American Institute of Mining Engineers contains a paper by C. C. Semple on the performance of the Huntington mill at gold mines in eastern Nicaragua.

Mount Perry.—The *Queensland Government Mining Journal* for September contains a description of the Mount Perry copper mining district in Queensland, situated between Rockhampton and Gympie, and owned chiefly by the Queensland Copper Co.

Problems in Copper Production.—The *Mining and Scientific Press* for October 7 contains a lengthy and valuable review of the problems in connection with the exploration, mining, concentration, and smelting of copper deposits in the United States that have been solved during the last ten years.

Aluminium Works in Norway.—The *Engineer* for October 6, 13, and 20 contains articles by G. Wüthrich describing the electric and hydraulic works at Vigeland, in Southern Norway, built by the Anglo-Norwegian Aluminium Company. The capacity is 2000 tons of aluminium per year. The works are situated on the Otterdal river, ten miles from its mouth at Christiansand, and the fall is 59 ft. The article does not touch the metallurgy.

Electric Furnaces.—At the October meeting of the Faraday Society, J. Harden read a paper on the 'Paragon' electric furnace, and E. Kilburn Scott, a paper on the Hering 'Pinch-Effect' furnace.

Electric Smelting of Nickel Ore.—W. L. Morrison presented a paper at the September meeting of the American Electrochemical Society, describing experimental work in connection with the electric smelting of nickel ores at Webster, North Carolina.

Vanadium.—*Chemical and Metallurgical Engineering* for October contains a further instalment of a lengthy article by W. F. Bleecker on the chemistry and metallurgy of vanadium.

Tin in Malaya.—In the *Mining Journal* for October 14, J. B. Scrivenor commences a series of articles on prospecting for tin in the Federated Malay States.

Transvaal Coal. — The *South African Mining Journal* for September 23 and 30 contains articles by F. A. D. H. Moseley on the value of Transvaal coal for export purposes.

Lorraine Iron Ores.—In *Revue de Metallurgie* for October, A. Guillain reviews the iron ore production of French and German Lorraine.

Water in Minerals.—The *Journal of the Franklin Institute* for October contains an article by W. W. Coblenz on the conditions of existence of water of combination and constitution in crystals and minerals.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be supplied on application to The Mining Magazine.

BOOKS REVIEWED

GRAPHICAL SOLUTION OF FAULT PROBLEMS. By C. F. Tolman, Jr. Cloth octavo, 48 pages, illustrated. San Francisco: *Mining and Scientific Press*: London: *The Mining Magazine*. Price 4s. 6d.

This is a reprint, with additions, of an excellent series of articles that attracted much attention when they appeared in the *Mining and Scientific Press* last summer. We shall give an extended notice in our next issue.

TECHNICAL METHODS OF CHEMICAL ANALYSIS. By George Lunge, translated by C. A. Keane. Vol. II. Large octavo, 2 parts, 1294 pages, illustrated. London: Gurney & Jackson. Price 63s. For sale by *The Mining Magazine*.

It is needless to say that every analytical chemist and assayer must own these encyclopedic works; especially Volume II. now issued, as it reviews the analytical methods in connection with the metals. Other subjects included in this volume of interest to the inorganic chemist are, artificial manures, explosives, calcium carbide and acetylene, illuminating gas and ammonia.

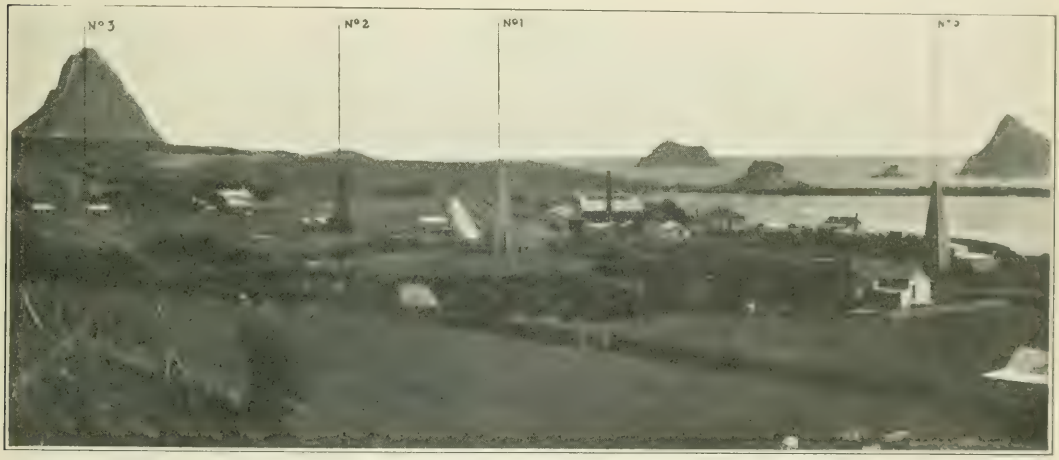
THE CHEMISTRY, PROPERTIES, AND TESTS OF PRECIOUS STONES. By John Mastin. Leather, pocket size, 120 pages. London: E. & F. N. Spon. Price 2s. 6d.

It is difficult to read this book with any satisfaction or confidence, for the author, in attempting, without the necessary skill, to write simple accounts of stones and their properties has brought forth only a series of complicated statements. Many of his assertions make even the expert rub his eyes.

THE COPPER HANDBOOK. Vol X. Compiled and published by Horace J. Stevens, Houghton, Michigan. Price 21s. For sale by *The Mining Magazine*.

Stevens' Copper Handbook has proved a most serviceable work of reference, and we are glad to receive a volume bringing the information up to date. Our readers should be by this time familiar with the scope of the book, but for those who are not we may say that it contains a reference to every copper mine and metallurgical works throughout the world, with information as to the directorate, control, capitalization, and nature of the business. These records form the bulk of the book, or, to speak precisely, occupy 1650 out of the 1900 closely printed large-octavo pages. The rest of the book is devoted to a general treatise on the occurrences of copper ores, the methods of mining, and metallurgical practice. We are not desirous of belittling the hard work and strenuous labours of Mr. Stevens, and in fact we are ready to give him full credit for excellent results, effected single-handed and in spite of several untoward adverse circumstances. Nevertheless, we are bound in justice to our readers to say that the book shows on almost every page signs of a lack of statistical adaptability and of the requisite facility of condensing and systematizing the knowledge placed at his disposal. For instance, he complains in the preface of the continual increase in the bulk of the book; but the expansion is really unnecessary, and is caused by the inclusion of unwieldy descriptions of plants and mines that are of no interest to the general reader and of no value to the specialist. For instance, Tanganyika Concessions is held up to ridicule for the space of eight pages, beginning with a fairy tale about King Leopold of the Belgians giving the concession to the Countess of Warwick, who in turn handed it to Cecil Rhodes, fol-

lowed by references to alleged mines, elusive smelters, and jibes as to the company becoming a fairly important producer in the 21st, 22nd, or 23rd centuries. All this is yellow journalism, and quite out of place in a book of reference, which should confine itself, with necessary discretion, to such official or general statements of the aims and objects of each company as are available. Then again some of the impolite entries are due to the carelessness or want of knowledge of the compiler ; it is not fair, for instance, to say that a letter was returned unclaimed from the "former office" of a company, when that company happens to be an old-established and reputable business house. Then the glossary might well be omitted, for it is only a source of merriment to the initiated and of worry to the inquirer. A steam hammer is a " heavy hammer actuated by steam or compressed air." Underlay is the " mineral bodies lying under a given tract though not outcropping on surface," and underlie is " the underlay." Burrow is "a rock burrow." An acid rock is " one in which bases are combined with acids forming salts." An alkali is "a lye—the opposite of an acid."



OIL WELL ON THE SEA-SHORE AT TARANAKI, NEW ZEALAND.

Oil Fields of New Zealand. By J. D. Henry. Cloth, large octavo, 350 pages, with many illustrations. London : The Author, 4 London Wall Buildings. Price 15s. For sale by *The Mining Magazine*.

A year ago we reviewed 'The Oil Fields of the Empire' by the same author, and mentioned that in later books he would continue his records of the oil districts of other countries under British rule. This book on New Zealand is welcome, for little has been written on the subject, and the resources of that far-distant country have hitherto not received the notice they deserve. Mr. Henry enters into full details of the history of these deposits, and of their present position and prospects. The largest part of the book is occupied with the Taranaki district, on the west coast of the North island, in the neighbourhood of New Plymouth ; then follow descriptions of the Gisborne district on the opposite side of the same island, and of the Kotuku district on the west side of South island, inland from Greymouth. A short note is added on the shale industry at Orepuki, at the extreme south of South island.

We give herewith a photograph of the coast at Taranaki, showing the three Sugar Loaves sighted first by Captain Cook in 1770. Later, in 1838, attention was drawn to Taranaki, because it was considered a suitable district for the formation of a colony, and this agitation caused the British Government to annex New Zealand before France obtained possession. The presence of oil in the district was known to the earliest settlers, for it was found floating on the sea round the Sugar Loaves, and the Maories had a tradition that the oil was the result of the burning of bituminous matter in a submerged island. It was not until 1865 that a technical examination of the land on the sea-shore was made. In that year samples were sent to London, and prospecting licenses were granted by the Government. Boring started in 1866, and gas and oil were struck at a depth of 20 ft. and 60 ft. respectively. Just at that time the New Zealand Geological Survey was created, and Sir (then Dr.) James Hector was appointed as chief. His first commission was to report on this new oilfield. The first ventures were not successful commercially, and the development of the district lay in abeyance until 1888, when interest was revived by H. A. Gordon, the Inspecting Engineer of the Mines Department. In the following year companies were floated in England to continue the work, and in 1906 there was a boom. Then came a second lull. During the last eighteen months, the deposits have been attracting attention again, and probably we shall hear more of the Taranaki oilfield in the near future. It is interesting to note that the celebrated iron sands are found in the same neighbourhood.

The Basic Open-Hearth Steel Process. By Carl Dichmann. Translated and edited by Alleyne Reynolds. Cloth octavo, 330 pages, illustrated. London : Constable & Co. Price 10s. 6d. For sale by *The Mining Magazine*.

The original German edition of this book was an elaboration of a series of articles that appeared in *Stahl und Eisen*, and the translation has been done by a practical and scientific steel metallurgist intimately connected with Sheffield. The book is not a guide to the construction of furnaces or a description of the process ; it consists rather of a close examination of the chemical and physical problems connected with this branch of metallurgy.

COMPANY REPORTS

Zaaiplaats Tin.—This company was registered in the Transvaal in August 1908 to develop tin deposits in the Waterberg district. Crushing started in February 1909. The present report covers the year ended July 31, and shows that 24,105 tons of ore was crushed, yielding 1763 tons of concentrate, averaging 70% tin. This sold for £190,553, out of which £111,000 has been distributed as dividend, being at the rate of 185% on the capital £60,000. Until the present time the battery has consisted of 5 heavy stamps and 10 light ones; the latter are now being replaced by 1550 lb. stamps similar to the other heavy ones. This has been made necessary by the increasing hardness of the ore. It is further announced that another 20 are to be added, as the extent of the orebodies is found to be far greater than was at first supposed. Additional dressing plant will also be required, as the cassiterite tends to become of finer grain and more disseminated in depth; also a roasting furnace to deal with the pyritic matter which is making its appearance. The report of Hans Merensky is incorporated with the directors' report; to this we have already referred in our pages. The mine manager is G. H. Furner, and during his absence on leave his place is occupied by C. Fred Thomas, late of South Crofty.

Rooiberg Minerals.—This company was formed in the Transvaal in May 1908 for the purpose of developing tin deposits situated on the northern slope of the Rooiberg range of hills, 40 miles west of Warmbaths and 70 miles north by west of Pretoria. The control was originally with the Oceana company, but passed later to the Anglo-French-Farrar group. Edward J. Way is consulting engineer, and Amos Treloar, late of East Pool, is manager of the concentration plant. The report now issued covers the year ended June 30, and shows that 17,781 tons of ore was sent to the mill estimated to contain 7% tin, and that 1077½ short tons of concentrate was produced averaging 67% metal, being a recovery of 58% of the content. The revenue from the sale of concentrate was £115,563, and the net profit was £52,674, out of which the first dividend yet distributed was paid, absorbing £13,500 or at the rate of 7½%, £4821 written off for depreciation, and £39,468 carried forward. Some months ago we recorded that a new treatment plant was being designed; that is now being built at a cost of about £40,000. By its means it is expected that the extraction will be greatly improved, and in additon the accumulated slime treated. The reserve of ore on June 30 was estimated at 21,650 tons, averaging 4½% recoverable content, but Mr. Way points out that these figures are quite unreliable, for thin seams of pure cassiterite are continually being found on stoping that could not be detected when making an estimate of reserve. He has found by experience that the mill-screen samples are generally higher than the mine samples. Mr. Way reports that his scheme of increased development has been retarded by scarcity of labour.

China Clay Corporation.—As recorded in our issue of April 1910, this company was formed by L. Ehrlich & Co. to acquire a tract of virgin china-clay land on the southern edge of Dartmoor, Devonshire. E. T. McCarthy is on the board, R. Hansford Worth is consulting engineer, and John Mutton is manager. The issued capital consists of £150,000 in ordinary shares, which were all issued as fully paid to the vendor and to the underwriters, and 120,000 preference shares of £1 each, on which 12s. 6d. has been called up. The report now issued covers the period from the incorporation of the company to June 30 of this year. The time has so far been occupied with preparatory work; a railway is being built to connect the Redlake property with the Great Western railway at Bittaford; the peat overburden has been removed, and a shaft sunk. This development work has fully confirmed the estimate as to the value and extent of the deposit over the tested area of 98 acres, namely, 2¼ million tons. A pipe-line 8 miles long has been laid to Cantrell, where the concentration and treatment plant is being erected. Of the working capital subscribed, £25,435 was paid as part purchase price, and £29,602 has been spent on the above-described work, leaving a sum of about £65,000 available for the completion of the programme. It is interesting to note that the peat overburden is proving useful as fuel.

Amalgamated Zinc (De Bavay's).—As recorded in our issue of November 1909, this company was formed in Melbourne to acquire and extend the flotation process developed by A. J. de Bavay. The plant treats zinc tailing from the North and South mines, the control of which is in the same hands, the Baillieu group, and the company has more recently obtained the contract for the tailing from Block 10 mine. The report now issued covers the nine months ended June 30 last, the odd period being due to the desirability of having the half-yearly accounts made up at the same time as those of the North and South mines. During the nine months, 319,256 tons of material was treated, producing 93,973 tons of zinc concentrate, assaying 48·1% zinc, 6·7% lead, and 9·1 oz. silver, together with 1457 tons of lead concentrate, assaying 55% lead, 28·2 oz. silver, and 11·6% zinc. The accounts are credited with £271,503, being the amount receivable from the European zinc smelters calculated on £22 as the price of the metal. As, however, the contract of sale provides for payment for any half-year's deliveries at the average price during the succeeding half-year, it is clear that this figure will be greatly exceeded owing to the recent advance in the price of the metal. After payment for the purchased tailing and of expenses of treatment and administration, the profit was £98,301. To give an idea of the possible eventual profit after readjustment of prices, we may mention that if the average price of zinc was £25 per ton the profit would be £134,841. The directors have distributed £75,000 as dividend, being at the rate of 15%.

Hainault.—This mine is in the northwestern part of the Golden Mile of Kalgoorlie, and has been a producer since 1901. The profits have not been so great as at some of its neighbours to the east and south, and the total dividends have only been 40% on a capital of £150,000. The control is in Scotland and Archibald L. Hay is manager. The metallurgical treatment is different from the present method adopted in the district, and is in fact a modified form of that generally in vogue in early days. Forty stamps crush to 8-mesh, and Cobbe amalgamating pans reduce it to 40-mesh. The discharge from the pans is classified into sand and slime, and the two concentrated separately. The concentrate is roasted and cyanided, and the tailing from the concentrators is cyanided. The report for the year ended May 31 shows that 62,332 tons of ore was treated, yielding gold worth £84,237. These figures compare with 69,098 tons and £93,639 during the preceding year. The expenses at the mine were £58,214, £13,229 was charged to mine development, and £5449 has been allowed for depreciation. After paying London expenses and taxes, the profit was £4607, out of which £3750 was paid as dividend, being at the rate of 2½%. The development work has disclosed about as much ore as was sent to the mill, and the reserve remains at approximately 100,000 tons,

averaging 6¾ dwt. On the eastern side of the property the conditions are hopeful for future additions to the reserve.

Whim Well Copper.—This company was formed in 1906 to acquire a copper property in the northern part of West Australia, in the West Pilbara district, and near the coast to the east of Roeburne. H. R. Sleeman is engineer. The present report covers the 15 months ended March 31, the odd period being

caused by the shifting of the time for making up the accounts from the hot season, when any additional work is an unbearable burden to the mine staff. In our notice last year, we recorded that the deposit is in a flat lode, oxidized at the surface and showing sulphides below by drilling. The deposit is extensive, and much of it is of high grade. At the present time the best ore is shipped to Europe and sold to smelters. During the 15 months under review, 11,636 tons was exported, averaging 14% copper, having a gross value of £97,000. After mining, shipping, and smelters' expenses were paid, the profit was £18,600, which, with the £17,127 carried forward from the previous year, brought the profit to £35,727. Out of this, £23,250 has been distributed as dividend, being at the rate of 12½%. Much attention has been given to the question of economically concentrating the lower-grade ore, and it was eventually decided to adopt the 'Murex' magnetic process. A plant capable of treating 200 tons per day is now being constructed.

Mexico Mines of El Oro.—This company used to be in the control of the Exploration Company, having been formed in 1904 to acquire the Mexico property containing the same vein, the San Rafael, as the El Oro and the Esperanza. Toward the end of 1910, the directors resigned owing to the opposition, on the part of the French and Pearson groups of shareholders, to the conservative policy of the Exploration Company. The office was removed, the board reconstituted, A. F. Main resigned the management of the mine to Fergus L. Allan, and Andre P. Griffiths was appointed consulting engineer. The report now issued covers the year ended June 30, and shows that 136,408 tons of ore was raised. From this, gold-silver bullion worth $1,528,229 was extracted, being a recovery of $11·20 per ton, of which about $9 was gold and the remainder silver. The average extraction was 88·8%. In the profit and loss account, the income from the sale of bullion was £311,758, and the expenses in Mexico £126,467. Expenditure on improvements, particularly in connection with the retimbering of the North shaft, absorbed £24,200, and £8000 was allowed for depreciation. The dividends amounted to £144,000, being at the rate of 80% per annum on the capital £180,000. The total distribution to date has been £427,500, and in addition £137,342 has been spent out of revenue on capital account. Mr. Allan reports that the South shaft has been re-timbered to 1100 ft., that is, between Levels 5 and 6, and that the North shaft has been sunk to 1305 ft., or 35 ft. below the seventh level. Of the ore raised, the largest amounts came from the 7th, 6th, and 4th levels, and smaller quantities from the 8th and 5th. The development work consisted of 11,208 ft. of driving and 929 ft. of shaft-sinking. The ore reserve was increased by 35,000 tons and on June 30 stood at 318,720 tons, averaging $9·50 gold and 6 oz. silver. The rich ore in the Sulphide vein is not nowadays sent to the smelter but is treated on the spot. There is nothing in the report to bear out the gloomy prophesy of a year ago, which pointed to a diminution in the grade of the ore and to a reduction in the amount raised due to difficulties in connection with the shafts.

Kerr Lake.—This company owns a silver mine in the southeastern part of Cobalt district, Canada. The control is with the Lewissohns, and John Seward is manager. The first profits were made in 1905. The report now issued covers the year ended August 31, and shows that the estimated content of the ore mined was 2,388,420 oz. of silver. The ore shipments were as follows: 481 tons of high grade averaging 3577 oz. per ton; 1270 tons of second quality averaging 362 oz.; 30½ tons of jig concentrate averaging 928 oz.; and 154 tons of slime averaging 75 oz.; in addition, metallics and dump material were sold containing 12,964 oz. and 34,534 oz. respectively; a total estimated content of 2,269,680 oz. The gross receipts were $1,231,245, against which $52,449 was charged for treatment and freight, $232,083 for mining expenses, and $9334 for administration, leaving a net profit of $937,379. The dividends distributed during the year amounted to $1,200,000, bringing the total to date $3,330,000. During the year, the sorting tables have been improved so as to reduce the number of men employed, and jigs have been introduced. The tailing from the jigs and the finer screening from the sorting tables are

sold to the Nova Scotia Mining Co. for treatment. An increased amount of development work has been done this year, and six new veins have been discovered, all promising to be important producers. Owing to the difficulty of making estimates, no figures relating to ore reserves are given.

Camp Bird.—This company, as we have already several times recorded, was floated in London in 1900 by F. W. Baker and J. H. Hammond to acquire from T. F. Walsh the gold mine of that name in Ouray county, Colorado. On the approaching exhaustion of the mine, the Santa Gertrudis silver mine at Pachuca, Mexico, was bought two years ago. The purchase was effected by the payment of cash out of reserve and issuing debentures, and with the capital so subscribed acquiring nearly the whole of the shares of the Santa Gertrudis company. The report now issued covers the year ended April 30. It shows that the amount of ore discovered during the year was very small, the ore reserve standing on April 30 at 38,415 tons, as compared with 83,900 tons the year before, in the meantime 79,186 tons having been extracted and sent to the mill. The yield was $1,685,979 in gold, or $22·89 per ton, silver worth $71,435, copper worth $8408, and lead worth $46,748, a total of $1,812,571. The recovery of the gold content was just under 95%. Of the total extraction of metals, 64·32% was obtained by amalgamation, 28·81% in the concentrate, and 6·87% by cyanidation. The concentrate was sold to the American Smelting & Refining Co. The total income at the mine during the year was £372,696, or £4. 14s. 1d. per ton, and the expenses £153,262, or £1. 18s. 8d. per ton, leaving a profit to be carried forward to profit and loss account of £219,434, or £2. 15s. 5d. per ton. The accounts are credited also with £83,691, the par value of vendors' commission shares in Santa Gertrudis, and are debited with £30,000 interest on debentures and £15,248 income tax. The dividends paid during the year have amounted to £220,002, being at the rate of 20%. The total dividends distributed to date have been £1,505,002. Since the close of the company's financial year, the debentures have been retired and preference shares substituted in their place. Information relating to the Santa Gertrudis company is given in the succeeding paragraph.

Santa Gertrudis.—As recorded in the previous paragraph this company was formed by the Camp Bird company in January 1909. The report now issued shows that the past eighteen months have been occupied in preparing the mine and mill for the contemplated greatly increased scale of operations. To protect the *avio* interests, separate companies have been formed in Mexico to do the mining and the beneficiation of the ores. Many improvements have been made in the shafts and their equipments, and in particular the old San Guillermo shaft has been repaired and made the main hauling shaft with a capacity of 1000 tons per day. An advantageous contract has been made with the Mexican Light & Power Co. for the supply of electric power. The new mill was ready for work on June 14 last. It consists of 60 stamps of 1550 lb. each, 10 tube-mills, 18 Pachuca vats, Merrill slime-filters, Dorr thickeners and classifiers, etc. W. J. Cox, the consulting engineer, and Hugh Rose, the manager, report that the developments have greatly added to the ore reserve, the figures now being 630,000 tons of proved ore estimated to yield a profit of $4,610,000, and 520,000 tons of probable ore estimated to yield a profit of $3,565,000, or a total of $8,175,000 or nearly £1,700,000. In January last, 225,000 new shares were created, and of these 93,000 have been issued for cash to the Camp Bird company.

Natomas Consolidated.—This company was organized under the laws of the State of California in November 1908 for the purpose of acquiring the properties of the Natoma Land & Mining Co., the Folsom Development Co., and the Feather River Development Co., all large operators of gold dredges in the Sacramento valley. The issued capital is $14,617,300 in shares, and $14,865,000 in 6% mortgage bonds. In the spring of 1910, five million dollars worth of the bonds were offered in London by the Hirsch Syndicate, the prospectus being based on a report made by C. M. Rolker. Another report by Mr. Rolker has now been issued, dated September 18 of this year. He shows that, of the 11 dredges taken over by the consolidated company, 2 have been scrapped, that a new hull is being built for Folsom No. 4, and that the plan of providing 5 new dredges with 13½ cu. ft. buckets is in hand, two having been commissioned in February and August of this year and another about to start at the time of writing the report. Another is to be ready in the spring and the fifth at the end of next year. The combined capacity of all 14 dredges will be nearly 28 million cubic yards per year. During the 18 months, January 1909 to June 1911, the yardage treated was 44,542,141 and the recovery $1,377,000; the cost was $1,841,463, and the dredging profit $2,535,537. The figures per cubic yard were: yield 9·95c., cost 4·08c., and profit 5·87c. The tested land contained a reserve on July 1 of 298,453,395 cu. yd., with a possible recovery of $29,715,195, and a profit of $17,531,657. The company also owns other ground only partly tested.

Jumbo.—This gold mine is situated in the Mazoe valley, north of Salisbury, Rhodesia, and has been producing since 1906 without paying a dividend. The controllers are the United Rhodesia Gold Fields, and the consulting engineer is H. A. Piper, of the Consolidated Gold Fields of South Africa. The report now issued covers the year ended June 30, and discloses the unfortunate fact that the lower levels of the mine are poor. No additional ore was found during the last nine months of the year under review, and the ore sent to the mill has been of lower grade. The 30 stamps treated 40,490 tons, the largest yearly amount yet recorded, and the yield by amalgamation and cyanide was worth £67,209, as compared with £85,437 the year before. The working cost in Rhodesia and London was £47,630; in addition, £12,815 has been written off for depreciation, and £10,122 allowed for redemption of mine development. The ore reserve stands at 30,803 tons estimated to average 9·81 dwt. In the old part of the mine, nothing is left but the pillars, and these are now being extracted. Mr. Piper recommends that prospecting should be continued below the 7th level; while he is not particularly hopeful, he reminds shareholders that similar critical conditions have been experienced before, and that the life of the mine has been renewed by perseverance in development.

Caucasus Copper.—This company was formed in 1900 to acquire a low-grade copper property at Dzansul in the Russian Caucasus. The ore is plentiful but difficult to concentrate, and its beneficiation has given a great deal of trouble. At first, direct smelting was tried, but had to be abandoned, as too much flux was required. Then magnetic separation was tried, with equally disappointing results. Finally, three years ago, James Colquhoun, who used to be manager of the Arizona Copper Co, was asked to join the board, and to advise as to treatment. Under his direction, water concentration has been tried once more, and sufficiently good results have been obtained. The plant can treat

500 tons per day, and the smelter capacity is 200 tons of copper per month. The concentration plant is to be increased so as to bring the daily amount of ore to 750 tons. This scheme would have been completed before now, but for the severity of the weather during last winter, when snow-storms and land-slides cut off communications and wrecked the pipe-line through which oil-fuel is delivered to the mine and smelter. The report and balance sheet for the year ended May 31 does not therefore show the position of the company to have improved since this time last year, when we gave in our issue of November 1910 an outline of the operations. In fact, the company has not yet arrived in a position when it is able, under Russian regulations, to issue a profit and loss account. During the year 1947 tons of copper was produced, as compared with 1140 tons the year before, but still 500 tons less than should be possible with the present unextended concentration plant. The profit from the sale of the copper is stated to have been £25,600, against which £23,500 has been written off for depreciation. This profit does not take into account London expenses and interest on debentures and loans, amounting in all to £67,100, or the expenditure on new plant and stores, which was as much as £37,600. The indebtedness of the company has therefore increased during the year by over £100,000. The capital of the company is £500,000, and there are £635,600 debentures, £534,900 loans, and £42,740 accrued interest on debentures and loans. A number of high-class mercantile firms in London are financially interested, the J. P. Morgan group being probably the heaviest involved. W. R. Van Liew is now general manager, having previously been chief metallurgist.

Chinese Engineering & Mining.—This company was formed in 1900 by Bewick, Moreing & Co. to acquire from Chinese owners through H. C. Hoover the collieries of Tong-shan and Lin-si at Kaiping near Pekin in Northern China. The report now issued covers the year ended February 28 last and shows that the gross profit was £192,592. The administrative expenses were £10,263; £25,700 was paid as interest on debentures, £10,000 in redemption of debentures, and £35,000 was placed to reserve for depreciation. The net profit was £112,207, out of which £100,000 has been distributed as dividend, being at the rate of 10%. In May it was found desirable to make an issue of second debentures to the amount of £50,000, being part of £250,000 authorized. An unfavourable situation is caused by the competition of the adjoining Lan-chow collieries, and it has been found necessary to cut prices. On the other hand the cost of mining has been substantially reduced. Efforts are being made to stop the competition by making an agreement with the Lan-chow collieries and eventually of amalgamating the two companies, but so far without avail. A proposal to erect coke ovens and sulphate of ammonia plant is under consideration.

Consolidated Main Reef.—This mine is one of the Neumann group, and is situated in the middle west of the Rand. Milling started at the beginning of 1898, and dividends were first paid in 1907. The report now issued shows that the profits have increased, and that the underground conditions have improved. The ore raised was 296,537 tons, and the amount sent to the mill was 252,485 tons. The percentage of waste removed by sorting was only 15%, as compared with 23% a year ago, so that more ore was sent to the mill. It has been possible to make this alteration in policy, partly because of the increase in the number of tube-mills, and partly because the average grade of the ore has been higher. The extraction was 62,214 oz. by amalgamation and 23,877 oz. by cyanide, a total of 86,091 oz., or 6·8 dwt. per ton milled, as compared with 6·3 dwt. a year ago. The revenue from the sale of gold was £360,211, or 28s. 6d. per ton milled, and the cost £272,237 or 21s. 6d. per ton, leaving a profit of £87,974, or 6s. 11d. per ton; £80,881 was distributed as dividend at the rate of 8¾%. Last year the profit per ton milled was 6s. 2d., the tonnage being only 235,391, the total profit £72,575, and the dividend £69,372, or 7½%. A sum totalling £86,631 was spent on machinery and shaft-sinking out of capital subscribed two years ago for the purpose of extending

operations. The unexpended balance of this capital stands at £221,000. Over 24,000 ft. of development work was done during the year. The reserve has been increased by 102,740 tons, at the same time the content increasing by 0·4 dwt., the figures on June 30 being 516,890 tons averaging 6·7 dwt. over 42 inches. The reports by S. C. Thomson, the consulting engineer, and C. H. Spencer, general manager, also show that, by the increase in the tube-milling plant, the extraction has been raised from 90 to 93%, and that the new vertical shaft to strike the Main Reef Leader at 2500 ft. is down 823 ft.

Main Reef West.—This mine also belongs to the Neumann group and is situated immediately to the west of the Consolidated Main Reef. S. C. Thomson

and C. H. Spencer are consulting engineer and general manager respectively of the two mines. Milling started in 1909 with 80 stamps, and in 1910 40 more were added. At the beginning of February of this year 3 tube-mills were put into commission. Unfortunately the underground hauling and raising arrangements have not proceeded as rapidly as the surface work, so that there is not sufficient ore yet being hoisted to keep the stamps and tube-mills running for more than 18 days per month. The report for the year ended June 30 last shows that 13,739 ft. of development work was done, of which 1910 ft was shaft-sinking. The ore reserve was increased by nearly 200,000 tons, the figures on June 30 being 628,260 tons, averaging 7 dwt. The content has been decreased as compared with a year ago by the inclusion of several blocks in which the Main Reef and the Leader can be mined together. During the year, 231,608 tons was raised, and, after the removal of 15% waste, 196,391 tons went to the stamps. The production was 56,693 oz. by amalgamation and 24,306 oz. by cyanide, a total of 80,999 oz. or 8¼ dwt. per ton. The revenue from the sale of gold was £338,797 or 34s. 6d. per ton milled, the cost was £198,924 or 20s. 3d. per ton, and the profit £139,873 or 14s. 3d. per ton. In addition £96,732 was spent out of capital on the shafts, etc. The dividend absorbed £101,250, being at the rate of 22½%. It is expected by the end of 1911 that the West shaft, which was 2075 ft. deep in August, will be equipped sufficiently to make it possible to raise more ore.

New Modderfontein.—This mine is situated in the far east Rand and belongs to the Rand Mines group. H. Stuart Martin is consulting engineer. Operations commenced in 1896 with 40 stamps, and in 1909 the plant was increased to 180 stamps and 5 tube-mills. Early this year a Butters filter plant was added, bringing the monthly capacity of the plant to 52,500 tons. The haulage plant is, however, not quite ready for this rate of output. The report now issued covers the year ended June 30 and is highly favourable. Development work has increased the reserve by 760,000 tons and by ½ dwt. in content, the figures on June 30 being 3,452,195 tons averaging 7·6 dwt. The rise is due to the increased amount of high grade ore found in the eastern part of the mine. During the year, 600,976 tons was raised and, after the removal of 10% waste, 538,400 tons went to the battery. The recovery by amalgamation was 145,233 oz. and by cyanide 43,437 oz., a total of 188,670 oz. The yield per ton milled was 7 dwt. and the percentage of extraction was 97%. The gold was worth £791,623, or 29s. 5d. per ton milled, an increase of 2s. 10d. per ton as compared with the preceding year. The working cost was £465,548 or 17s. 4d. per ton, leaving a profit of £326,074 or 12s. 1d. per ton. Taxes absorbed £32,064 and £21,637 was placed to the account of capital expenditure. The dividends absorbed £297,500, being at the rate of 21¼%, as compared with £165,000 for the previous year. It will be remembered that 18 months ago £550,000 of new capital was subscribed for the purpose of developing the mine on a larger scale, providing new reduction plant, and electrifying the machinery. During the year £222,000 has been spent in this way. The new main circular shaft, 18 ft. in diameter, is down 425 ft.

Consolidated Gold Fields of South Africa.—The annual report of this South African corporation for the year ended June 30 shows that the net profit was £792,883, as compared with £993,381 a year ago, and £1,283,851 the year previous. Out of this, £100,000 has been written off the value of shares in producing mines, so as to provide against their exhaustion; the figure compares with £200,000 a year ago and £500,000 the year before. The dividend on the ordinary shares is £600,000 or 30%, as compared with 35% last year. During the year the 6% preference shares have been increased from £1,250,000 to £2,500,000, in order to provide funds for the expansion of the company's business outside the Transvaal, especially in America, and the debenture issue has been reduced by £25,000 to £225,000. The reserve fund remains at £2,000,000, half of which is invested in the company's business and half in gilt-edged securities. The report records the failure of the Simmer East, the acquisition of claims from the Booysen Estate adjoining the Robinson Deep, the formation of a subsidiary to handle Rhodesian interests, and another to manage the American business. The prospects of success in West Africa are discussed, and the necessity for a reduction in cost is emphasized; with this object, the government of the Gold Coast colony is asked to assist in recruiting cheap labour. The reports of the engineers, C. D. Leslie and H. A. Piper, describe the progress on the Rand and in Rhodesia. The reports of the various mines belonging to the group, Simmer, Robinson Deep, Knights Deep, Simmer Deep, and Jupiter are made up on July 31, a month later than that of the parent company, so they are not available for our present issue.

TRADE NOTES

Most of the trade publications mentioned in this column are available for distribution and the manager of "The Mining Magazine" will be pleased to secure copies for persons interested.

The Dorr Cyanide Machinery Company's London office is at 17 South Street, South Place, London, E.C. Mr. William Russell is the special representative.

The Merton Furnace Co. report the shipment of a Merton roaster to the Whim Well copper mine in West Australia; by its means hematite will be reduced to magnetite which is required in connection with the Murex concentration process.

The British Humboldt Engineering Co., Ltd., advise us that the Mawchi Tin & Wolfram Mines, Ltd., have recently placed an order for a complete magnetic separating plant for the Mawchi Co.'s mines in India. The plant is sectionalized, so that the gross weight of the heaviest individual part does not exceed 400 lb. The plant can thus be transported on elephants' backs to the company's mines situated about 20 miles from Pazaung in the Karenni State, India.

Chester's Renfrew Engineering Co., Ltd., announce the purchase of the works of Edward Chester & Co., Ltd., at Renfrew, Scotland. The existing plant has been enlarged and modernized, and the new company is in a position to quote prompt delivery and reasonable prices for engines, compressors, water-tube boilers and mining machinery of every description.

The Sandycroft Foundry Co. have just completed a large winding-engine driven by steam power to be erected at the new vertical circular shaft of the Champion Reef gold mine in India. The horse-power is 5500, and it will raise 15½ tons at the rate of 3000 ft. per minute from a depth of 3700 ft. There are two cylinders, one at each end of the drum, 42 in diam. and 84 in. stroke, fitted with Corliss gear. The drum is cylindrical with conical ends; the maximum diameter is 20 ft. and the length 14 ft. 6 in. A Gott controlling gear is provided for preventing over-speed, over-winding, and starting in the wrong direction.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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STATISTICS

Stocks of Copper in England and the Continent.
Reported by Henry R. Merton & Co.

	Sept. 30 Tons	Oct. 31 Tons	Nov. 30. Tons
In England	52,111	48,357	44,597
In France	5,654	5,704	5,485
Afloat from Chile	2,375	2,075	2,250
Afloat from Australia	7,200	5,900	6,350
Total	67,340	61,836	58,682
In Rotterdam	7,250	6,900	5,700
In Hamburg (estimated)	11,100	10,200	8,900

American Copper Producers' Association.
In Tons of 2,240 lb.

	Production.	Deliveries: Domestic	Deliveries: Foreign	Deliveries: Total	Stocks at end of month
January 1911	51,650	18,785	23,753	42,538	63,591
February	49,030	22,553	20,139	42,692	69,929
March	58,273	29,500	26,375	55,875	72,325
April	52,716	23,396	27,736	51,132	73,909
May	56,679	28,814	27,669	56,483	74,105
June	55,605	27,525	31,902	59,427	70,283
July	50,075	25,438	33,429	58,867	61,491
August	56,024	26,757	31,185	57,942	59,573
September	51,602	25,587	22,689	48,276	62,899
October	52,792	28,602	26,832	55,425	60,267
November	49,945	30,375	29,932	60,307	49,905

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Totals, 1910	7,228,588	305,532	7,534,120	32,002,912
January 1911	625,862	25,201	651,027	2,765,386
February	585,683	24,965	610,828	2,594,634
March	649,247	26,818	676,065	2,871,740
April	638,421	29,293	667,714	2,836,267
May	658,196	27,755	685,951	2,913,734
June	657,025	27,544	684,567	2,913,734
July	679,881	29,377	709,258	3,012,738
August	682,405	31,002	713,407	3,030,360
September	669,773	30,852	700,625	2,976,065
October	677,923	30,721	708,644	3,010,130
November	691,462	28,067	719,729	3,057,213

Cost and Profit on the Rand.

Month.	Tons	Yield per ton	Costs per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
January 1911	1,865,232	26 6	17 11	10 1	930,059
February	1,712,198	28 0	18 3	10 3	874,612
March	1,960,678	28 6	17 11	9 9	949,415
April	1,926,583	27 7	17 6	10 1	971,858
May	2,002,926	27 7	17 10	9 7	956,823
June	1,986,559	27 6	17 11	9 8	960,381
July	2,095,220	27 2	17 10	9 4	969,687
August	2,107,809	26 8	17 9	8 11	967,457
September	2,037,329	27 4	18 1	9 4	952,665
October	2,083,500	27 0	18 0	9 1	948,278

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31	183,268	8,357	9,991	201,616
February 28	189,434	8,513	9,814	207,761
March 31	193,457	8,493	10,061	212,011
April 30	194,328	8,511	10,272	213,111
May 31	190,392	8,379	10,425	209,196
June 30	186,940	8,212	10,597	205,749
July 31	181,582	8,122	11,054	200,758
August 31	179,810	8,182	11,292	199,284
September 30	179,619	8,045	11,475	199,139
October 31	179,194	8,078	11,319	198,591
November	176,736	8,043	10,071	194,850

Gold Output of India.

Year 1909	Year 1910	Nov. 1911	1911 to date
£2,083,901	£2,104,858	£186,225	£1,781,876

Production of Gold in Rhodesia.

Month.	1908	1909	1910	1911
	£	£	£	£
January	199,388	204,666	227,511	207,903
February	191,635	192,497	203,888	203,055
March	200,615	202,157	228,385	231,947
April	212,935	222,700	228,213	221,296
May	223,867	225,032	224,888	211,413
June	224,920	217,600	214,709	215,347
July	228,151	225,234	195,233	237,517
August	230,792	228,296	191,423	243,712
September	204,262	213,249	178,950	225,777
October	205,466	222,653	234,928	218,862
November	196,668	236,307	240,573	—
December	217,316	233,397	199,500	—
Totals	2,526,007	2,623,788	2,568,201	—

Production of Gold in West Africa.

Month.	1909		1910		1911	
	Oz.	Value	Oz.	Value	Oz.	Value
		£		£		£
January	22,817	91,112	17,357	70,699	15,903	66,107
February	21,403	86,210	16,976	68,469	15,179	63,081
March	23,186	93,556	17,627	71,954	16,387	67,673
April	21,491	88,071	16,363	67,069	17,237	70,880
May	25,104	100,056	16,590	68,355	24,427	96,409
June	17,340	70,561	17,194	70,988	22,555	92,174
July	17,331	70,523	15,564	58,551	22,510	91,955
August	17,766	71,614	13,921	57,713	25,385	103,753
September	18,125	72,963	11,497	47,746	26,717	109,039
October	15,957	65,813	13,341	55,046	26,826	109,503
November	17,882	73,824	14,021	57,658	—	—
December	17,570	71,332	15,042	61,737	—	—
	235,972	955,635	185,493	755,985	—	—

Production of Gold in Western Australia.

Month.	Export oz.	Mint oz.	Total oz.	Total value
				£
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
January 1911	17,463	102,035	119,498	507,592
February	22,047	84,991	107,038	454,666
March	12,296	93,267	105,563	448,426
April	20,455	91,791	112,246	476,787
May	22,076	88,952	111,028	471,615
June	10,523	106,464	116,987	497,188
July	15,334	97,387	112,721	478,805
August	11,521	102,477	113,993	484,168
September	5,011	114,615	119,626	508,135
October	10,664	106,733	117,397	498,668
November	9,762	108,646	118,408	502,962

Other Australasian Gold Production.

	1909	1910	November 1911	1911 to date
	£	£	£	£
Queensland	1,916,468	1,840,337	141,350	1,479,110
New South Wales	869,546	803,727	40,851	689,220
New Zealand	2,006,910	1,896,322	142,512	1,678,127
Victoria	2,897,340	2,422,700	179,985*	1,770,107*

* October figures only.

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
September 4, 1911	220	£25,262	£114 16 8
September 18, „	240¾	£27,170	£108 15 9
October 2, „	224¾	£25,221	£112 4 4
October 16, „	251	£28,342	£112 19 1
October 30, „	235½	£27,176	£115 8 0
November 13, „	248¼	£28,274	£113 17 11
November 27, „	232¼	£27,385	£117 18 3

Exports of Tin and Ore from Straits and Bolivia.
Reported by A. Strauss & Co.

	Oct. 1911 tons	Nov. 1911 tons	1911 to date tons
Metal from Straits to Europe and America	4,385	5,045	49,370
Metallic Content from Bolivia to Europe	1,947	1,363	20,657

REVIEW OF MINING

INTRODUCTORY. — Political events have continued to affect the share markets. Sir Edward Grey's speech on November 27, explaining British policy, was deemed pacific but it was not followed by any notable increase of speculation. Paris has been selling South African shares, being much depressed by the East Rand fiasco. A committee has been formed with a view to protecting French holders of Transvaal shares. The report of the East Rand commission of inquiry has made a profound impression. Incidentally it accentuates the objection to registration of companies in the Transvaal so long as they look for financial support in Europe. Obviously there is lack of control. Regrettable as are the recent exposures of mismanagement, as at the Prestea and East Rand, it is well that the real facts should be recognized and that those who find the money for mining enterprise should protest against the irresponsibility exhibited by their trustees on the directorates. Despite some adverse factors the general trend of the market is toward a recovery of cheerfulness and activity. Copper consumption is improving. Legislation in America is less of a menace to capitalized industry. Political developments in Europe are not so perturbing. Dividends are accumulating. An increase of speculation is probable in the near future.

TRANSVAAL.—The gold and labour statistics for October were not remarkable; if anything, they were disappointing. This is due mainly to the decrease from the Witwatersrand Deep mine, which was troubled by water. The output of 708,644 ounces, worth £3,010,130, has only been exceeded in July and August, but the rate of production per diem was less than in September. With two more monthly returns at about the same rate the production for 1911 will be worth £35,000,000, as against £31,995,266 in 1910. The labour returns exhibit a decrease of 425, the total number of natives employed on gold mines being 179,194, as against 180,103 in the corresponding month of last year. However, a year ago the decrease in October was 2097 and in November it was 2076, so there is a chance of improvement. On the other hand, some 600 additional stamps are now at work; so that the demand for labour has grown while the supply is no better.

Mr. H. O'K. Webber, president of the Chamber of Mines, stated recently that the number of 'boys' returning to their kraals has been larger than usual, but it was hoped that by June next the supply of labour would show an increase for the year. Recruiting in Portuguese territory is proceeding as usual but in British South Africa the supply of foodstuffs is so good as to encourage idleness among the natives. Competition for labour from farming and other industries is being keenly felt by the mining companies. It is hoped that the Union Government will exercise paternal interest in the subject and investigate the causes underlying the acknowledged shortage of labour at Johannesburg.

We note with interest that Messrs. Lewis and Marks, the South African operators, have incorporated their successful business in the style of Lewis and Marks, Ltd., in a company having an issued capital of £1,500,000. In addition to Messrs. Isaac Lewis, Barnet Lewis, and Samuel Marks, the present partners, the directorate will include Mr. C. F. Rowsell, who has long held the signature of the firm and is chairman of many companies.

The City Deep has been the victim of adverse rumours for several weeks, first in regard to defects in the mill, and then with reference to the titles of its mining claims.

Undoubtedly some basis does exist for the belief that the new mill has not given satisfaction. We are informed that the use of reinforced concrete in the king-posts has proved a mistake. The adoption of the Nissen stamp was announced so soon after the mill had been erected as to warrant the belief that the plant was not doing as well as had been expected. As to titles, the official denial of any defect must be accepted. The output of the mine is increasing and the cost is being decreased, but the full capacity of the plant will not be reached until next summer.

The Modderfontein B announces excellent results for November, 31,025 tons yielding 12,214 ounces. The working cost is 18s. 6d. and the profit 14s. 6d. The total profit is given as £22,497, but the real figure is about £30,000, no less than 2559 oz. having been put to reserve. This is done because the yield is above the average of the mine.

The Cinderella Consolidated has effected a connection underground on the 3000-ft. level with the Cason shaft, so that it now has two outlets. It will be remembered that the Cinderella Deep vertical shaft cut the banket in the early part of 1906 at 4003 feet and that sinking was continued to 4123 feet, so as to allow space for ore-bins. The main incline shaft was started at 3900 feet and has now reached a depth of 1000 feet on the incline.

RHODESIA.—The gold output in October was only 51,974 ounces valued at £218,862, which is the lowest yield since June. No declaration is made by the Claremont, Matabele Queen, and Surprise mines. As usual, the official statistics are incomplete, some companies giving their output in ounces, others in pounds sterling; the supposed profit is not calculated on a uniform basis, some excluding essential items of expense. The productive mines number 162, but 24 of them produced 70% of the total gold.

The announcement of a further decrease in the supply of native labour in Rhodesia is accompanied by the statement that the Chamber of Mines has decided that the minimum rate of wages offered on recruiting shall be increased 33% for surface labourers and 10% for those working underground. Even this increase will not bring the rate up to that of the Rand, but it may stimulate employment.

The cablegram informing the shareholders in the Surprise that the so-called 'reef' cut at 130 feet is "poor but solid" adds a final touch of humour to a serio-comic mining enterprise. The "solid" quartz assays 1 pennyweight per ton. It might be useful for manufacturing ginger-beer bottles for Rhodesians hampered by a noble thirst. It is a curious survival of 'true fissure' days to imagine that a "solid" quartz vein is more deserving of economic respect than an ill defined lode consisting of country-rock impregnated with quartz and more valuable minerals. Great men spring from "poor but honest" parents, but great mines do not spring from poor but solid veins of hungry quartz.

The resignation of Dr. Hans Sauer from the directorates of a number of companies is a noteworthy event, but one that is not calculated to injure the prestige of the Rhodesian mining industry. We hope it may synchronize with a policy more considerate to the rights of shareholders and better designed to win public confidence.

Announcement is made of negotiations with a view to the transfer of the Rhodesian Exploration & Development Co. to the control of the Consolidated Gold Fields of South Africa by absorption into its subsidiary, the Gold Fields Rhodesian Development Co. Owing to recent disclosures it is likely that the change will receive public approval, but it will need more than this or any other manipulation of interests to win public confidence. Greater regard must be shown for the rights of shareholders, by prompt and frank reports, not the belated and cryptic statements that now pass as information.

WEST AFRICA.—The October statistics are satisfactory, showing the largest gold production as yet recorded, namely, 26,826 ounces, valued at £109,503. The total for the ten months of the current year is 213,126 oz., as compared with 200,520 oz. in the first ten months of 1909. Not much reason exists for congratulation, but at least less cause for depression may be discovered, seeing that in 1910 the comparative total was 156,430 ounces. Among the outputs of individual mines, that of the Ancobra Dredging Co. is noteworthy, the output having doubled as compared to any recent month. The Prestea exhibits a decrease, from £23,778 to £20,132. The Ashanti Goldfields maintains its premier position, with an output worth £41,422. The Broomassie, Abosso, and Taquah mines hold their own.

The Taquah Central has struck a new lode of goldbearing banket in a cross-cut from the main shaft. It is a friable ore and gives promising assays. Further cross-cuts will be extended to intersect this lode from the present bottom level. The Fanti Syndicate publishes most satisfactory assays of samples broken in two prospecting shafts. Three feet of 25 to 30 dwt. ore is recorded. The West African Trust has secured an option for two years on the properties of the Sefwi Goldfields. An experimental plant will be erected to test the ore as development progresses. A belated cablegram from the Prestea announced that the output for November would be cut down to 10,000 tons of ore, owing to pipe-laying in the Appantoo shaft.

At the Ashanti Goldfields, the exploration of the Obuasi shoot on the 8th level from the main shaft continues to give good results. At 100 ft. nearer to the main shaft than the development reported last month, a cross-cut has disclosed a width of 15 ft. of ore averaging 15 dwt. per ton.

Monthly statistics of production are published to indicate the work being done by the Nigerian tin mines, but these statistics are nearly worthless, and probably misleading, since no uniform unit is employed. The 'tin' is in the form of a concentrate of variable composition, which is not stated, so that no basis of comparison exists.

AUSTRALASIA.—The October returns from the Associated denote decided improvement, the profit increasing from 3s. 1d. to 7s. 4d. per ton. The Golden Horse-Shoe and Perseverance both retrograded. The Oroya Links shows the improvement due to greater tonnage. The New Zealand group is doing well.

The report of the West Australian Department of Mines for 1910 has just been issued. It is belated, as is usual with such official statistics, but it contains some interesting information. For instance, the working cost is higher, largely on account of the harder rock penetrated by the deeper workings. But this is slight relatively to the great decrease in yield, from an average of 77s. per ton in 1903 to 42s. in 1910. This is accompanied by a proportionately lower profit, from 18s. in 1903 to 7s. per ton in 1910. A pathetic touch is to be detected in reference to Bullfinch, it being stated that "the rich discoveries in the Yilgarn field had caused a boom, with resultant inflow of capital, which it is sincerely hoped will have happy results." It may be sincerely hoped, but it cannot be intelligently expected. Capital, like water, can be easily spilled, but is recovered with difficulty when once it has irrigated a barren enterprise.

The Great Cobar meeting passed quietly. Disappointment over results was explained as being due to labour troubles, which have hindered other Australian companies. Another reason is the neglected development of the parent mine, it being apparent that metallurgical problems have diverted too much attention from systematic operations underground. Finally, the purchase of the Cobar gold mine has involved delay and expense by reason of the need to put it also into satisfactory shape.

We note with pleasure that Mr. W. Pellew-Harvey has been elected a director. He was a moving spirit in the Cobar gold mine, and his presence on the board of the Great Cobar will be an element of strength.

The Mt. Lyell strike, in Tasmania, was ended, by a provisional agreement, on November 12. A conference is to meet shortly with a view to considering an increase of wages. Both parties appear willing to make reasonable concessions. The Golden Horse-Shoe strike is also ended. Labour trouble, due to the union having prohibited work on contract, has disorganized operations at the Ida H. mine, also in Western Australia. This has led to the passing of the dividend, but better conditions are anticipated.

The transfer of the Oroya Exploration holdings to the Lake View Consols, with the absorption of the Black Range by the Yuanmi company, has been endorsed by the shareholders. This will give the Lake View a diversified and scattered interest in mining enterprises and consolidate the power of an able group, led by Messrs. H. C. Hoover and F. A. Govett.

The Einasleigh copper mine in North Queensland is to be purchased by the Chillagoe company, the payment being made by 175,000 new shares of 10s. each. For two or three years the copper and lead mines in the Chillagoe neighbourhood have been yielding less ore than formerly and the Chillagoe company's smelter has been short of supplies. The Einasleigh mine, about 175 miles south, on the Etheridge railway, has been one of the smelter's chief sources of copper ore during the last year. The consolidation of interests will be in favour of shareholders in both companies.

We note with approval that the managers of the Great Fitzroy have cut down their estimate of ore in reserve owing to the necessity for leaving pillars to support the workings. Such pillars may subsequently be recovered, but it is unlikely that all of them will be available for the mill. The latest news in regard to the metallurgical work is more encouraging, the extraction having been raised to 82% copper and 76% gold. If this is confirmed by further work it will constitute a notable success for the oil-flotation process. The trouble hitherto appears to have been a large proportion of impurities in solution, now overcome by softening the water with lime.

The west lode has been cut on the 14th level of the Sons of Gwalia. This ore-shoot has now been traced from the surface to the 14th level. It averages 10 to 12 dwt. per ton for a width of 10 to 12 feet, for a maximum length, so far proved, of 300 feet. It constitutes one out of several supplementary ore-bodies in this mine. The recent assays from the bottom of the Great Fingall are not so good. The maximum length of the new ore-body is 430 feet, on the 17th level, where it averages about 10 dwt. per ton.

INDIA.—The final dividend of the Champion Reef for the year ended September 30 brought the total distribution to 43⅛%, as compared with 23⅓% for the previous year; this is the highest dividend since 1907, when the workings came into the poor zone. The mine continues to develop well in depth, though the average grade is much lower than in the old palmy days. The chief factors in the increase of profit have been the reduction in working cost and a slight rise in the content of the ore treated. The Dharwar group of mines has finally been abandoned, owing to the poor results obtained below ground and also in the metallurgical plant. It will be remembered that eighteen months ago the Dharwar Reefs company was reconstructed as the Kabulgitti Co., with the object of continuing development and providing a modified plant for treating the accumulated tailing, but as only a limited number of shares were subscribed the mine was not re-opened and operations were centred on the metallurgical treatment. It

was known that the graphitic content was against easy extraction, and all sorts of methods were tried with the object of minimizing its effect. Unfortunately no method has been devised that was cheap enough. The plant and the property are therefore to be abandoned.

UNITED STATES.—Dredging for gold in California is an expanding industry. The official statistics for 1910 are available and show that the total gold produced by dredging was $7,550,254. Yuba county is credited with $3,172,476, an increase of $730,557 as compared with 1909: Butte gave $2,389,235, a decrease of $501,038; Sacramento gave $1,369,594, also a decrease of $164,542. Among individual companies the Yuba Consolidated contributed $2,927,246, the yield being 20·88 cents per cubic yard and the cost 5·67 cents. The Natomas worked 9·64c. gravel at a cost of 4·52 cents per cubic yard.

We tell the story of the Tomboy elsewhere. The recent annual meeting was rendered important by the information concerning the purchase of additional property, covering the extension of the Argentine lode. Apparently the transaction is highly favourable to the Tomboy shareholders, prolonging the life of the company and giving it a new reserve of ore, besides possibilities of development, on most reasonable terms.

An embittered litigation has been started between the Golden Cycle and Christmas mining companies at Cripple Creek over ore in disputed ground and other matters. This has been anticipated by the distribution of profits by the Christmas in the shape of a dividend of 70 cents per share, amounting to $1,050,000. Mr. John T. Milliken is the central figure in this imbroglio.

An important scheme has been placed before the shareholders of the Arizona Copper Co., the headquarters of which are in Edinburgh, involving the extension of the concentrating plant and the re-building of the smelter, the object being to permit of the beneficiation of large deposits of low-grade ore. Oil-fired reverberatories are to be adopted, the heat of the gases being utilized further for the production of electric power. The output of ore will be increased from 750,000 to 1,000,000 tons per annum, and of copper from 15,000 to 20,000 tons. The saving in cost is estimated at £200,000 per annum, equal to a reduction of 2 cents per pound. The scheme has been prepared by Mr. L. D.

A STOPE THAT CAVED IN THE ARIZONA COPPER CO.'S MINE AT MORENCE.

Ricketts, and is endorsed by the former manager, Mr. James Colquhoun. The capital expenditure involved will be £450,000 and the money is to be raised by the issue of terminable debentures. Mr. Ricketts estimates that the known reserve of ore will yield 200,000 tons of copper, and that development will reveal substantial continuations of the orebodies.

Referring to British interest in the Plymouth mine, on the Mother Lode, California, it is interesting to note that a neighbouring property, the old Kennedy, has struck specimen ore. This mine is 3970 feet on the dip and 3550 feet vertical.

James B. Grant died on November 2. As one of the founders of the Omaha & Grant Smelting & Refining Co., subsequently a part of the combination known as the American Smelting & Refining Co., he played an important part in metallurgical affairs, especially in Colorado. He was at one time the Governor of that State and took a useful share in all public movements. As a young graduate from Freiberg he went to Leadville and started one of the first smelters in that locality, exhibiting the shrewdness and energy that made him so successful, until he became absorbed in share speculation. His kindly personality will be missed among a large circle of friends and his demise marks the closing of an era during which the Colorado smelters dominated mining in the Rocky Mountain region.

CANADA.—Our Toronto correspondent sends the latest Porcupine and Cobalt news. The Temiskaming Mining Co. of Cobalt, by Mr. Burr Cartwright, the president, has bought the 138,000 shares of North Dome held by P. Kirkegaard for $1·70 per share.

SIBERIA.—The Kyshtim is now the largest producer of copper in Russia. Large sums of money are being spent in further expansion of operations and equipment of plant. The output for the current year will be about 5000 tons, and next year it ought to be fully 6500 tons of copper. This is being produced at a cost of £30 per ton, as against a market price in Russia of £85, the import duty making the price £25. 10s. more than the standard London rate. The refinery extracts £10 worth of gold from each ton of metallic copper.

The Atbasar issues a good annual report, of which the most interesting portion is Mr. R. Gilman Brown's estimate of the resources of the property. He considers that 389,000 tons of ore has been proved, representing a gross value of over £3,000,000. As yet only a small part of the company's territory has been tested. A smelting plant to produce 5000 tons of copper per annum is to be erected.

SPAIN.—For the last year the Pena Copper Mines company has been harassed with litigation instituted by the Rio Tinto company with regard to alleged unfair cutting of prices for pyrite in contravention of the agreement whereby the Rio Tinto railway carries the Pena products to port. The Rio Tinto company has repeatedly been beaten in the Courts. In order to be free from this transport trouble, the Pena company has agreed with the Spanish Government to finance the construction of a branch line connecting with a different line of railway to the coast. For the purpose of raising the necessary capital, the shareholders of the Pena company agreed last month to subscribe for 150,000 new shares of £1 each.

VARIOUS.—Shortage of labour is reported by the Ouro Preto, in Brazil. However, it is not acute, judging from the excellent work done during the past year. Extraction of gold from the ore has improved from 91·87 to 92·15 per cent.

Ferrobamba affairs are developing. Tests made by Mr. Claude Vautin prove that the oxidized ore and the bornite ore can both be concentrated when treated separately, and that the mixed product will then represent a concentration of 11 : 1, containing 30% copper, and suitable for reverberatory smelting. The American group, headed by Mr. A. C. Burrage, has now got 60% of the shares.

EDITORIAL

WHEN PUBLISHING reports giving the opinions and recommendations of their mine manager or consulting engineer, it is advisable for mining companies to state the name of the engineer. Upon the reputation of the man himself depends the value of his professional opinion. Personal responsibility is essential to mine reports.

EAST RAND affairs prove for the *n*th time that technical practice suffers by the use of wrong terms. Rock that cannot be exploited profitably is waste. No good comes from describing it as "ore below the officially-accepted pay limit." Not only shareholders, but managers also, are confused by the constant employment of terms that lead inevitably to unscientific modes of thinking. The entire subject of Rand economics is brought to the verge of absurdity by a terminology that is unworthy of a great industry based upon the application of technical science.

DEPRESSION in the mining market may shortly be mitigated, for it is announced that Mr. Thomas W. Lawson, of Boston, has acquired control of the Preston East Dome mine at Porcupine. Needless to say such control of a mine is, in Mr. Lawson's case, usually accompanied by a campaign of publicity that never lacks gaiety. The specimen ore found in Northern Ontario should afford good copy for his tropical imagination. The recent fire, the golden sidewalk, and the hidden assay-plans should all yield excellent material, wherewith the exponent of the System can weave a glittering fabric of literary spoof. We are in the dumps in London, and therefore anticipate the time when Mr. Lawson will give copious advertisements—to our contemporaries.

AMONG the anomalies of mine administration may be mentioned the signing of reports, as consulting engineers, by land, finance, or exploration companies. The value of a report depends upon the man who makes it, and when a report is signed by an accountant or secretary on behalf of a nondescript firm, however eminent in the financial world, then such a report is, to say the least, not convincing. Anyone accepting the guidance afforded by an opinion on a mine requires, or should require, the name of the engineer on whose inspection that opinion is based. We go even further and say that a corporation has no sense of honour such as may be expected of the individuals in that corporation. It is the personal equation that eternally affects all calculations of success on the part of a mining, industrial, or any other sort of enterprise.

RECENT CHANGES in the administration of the United States Geological Survey are noteworthy. Mr. C. Willard Hayes, chief geologist, under the director, Mr. George Otis Smith, resigned to accept a position as advisory geologist to S. Pearson & Son, in Mexico. On Mr. Hayes' resignation the post of chief geologist was offered to Mr. Alfred H. Brooks, who has special charge of the Alaskan work of the Survey; but the promotion was not accepted by Mr. Brooks. His decision to stick to a work to which he has devoted himself with so much energy and success is highly creditable to him, and will, we know, be cordially appreciated in Alaska. For ourselves, having an intimate acquaintance with the exploratory and geological labours of the officers of the U.S. Geological Survey in Alaska, we take the opportunity again to emphasize our keen appreciation of

the valuable service rendered by this scientific branch of the American government to one of the most interesting mining regions of the globe. We are glad indeed that the chief of that division of the Survey has decided to forego promotion in the desire to continue the work so well begun. It remains to state that Mr. Waldemar Lindgren has been appointed chief geologist in succession to Mr. Hayes. This is an excellent appointment. Mr. Lindgren has been on the Survey since 1884; for the last four years he has been in charge of metal statistics and the investigation of metalliferous deposits. He represents the modern school of geologists, who bring a more thorough knowledge of physics and chemistry to bear upon the study of ore deposits than was available among the earlier chiefs of the Survey. Among those engaged in mining Mr. Lindgren is known not only for a series of brilliant studies of great practical importance, but also for an engaging personality that is one of the many links between the representatives of science and the captains of industry.

DISCUSSION of a lively and forceful character marked the last regular meeting of the Institution. The origin of oil, a subject introduced by Mr. Eugene Coste at the previous meeting, was the topic for the occasion. Sir Thomas Holland delivered a clever and useful criticism, enlivened by telling touches of satirical humour, and based on facts collected during his official sojourn in India. Rarely have we enjoyed so much the effective use of criticism when applied to pseudo-scientific matters. Some of it, when read in cold print, will probably seem a little caustic, but when he said it he smiled. He was followed by Messrs. T. O. Bosworth and A. Wade, both of whom contributed something worth while. Indeed the whole discussion reached a level unusual at the Institution, especially in matters pertaining to economic geology. Amiability is usually carried to such an excess that, combined with the possible lack of real knowledge of a subject, the tendency is to replace useful criticism with wordy compliment. The highest compliment to an author is serious criticism. We trust that Mr. Coste takes this view. He replied with spirit, but became entangled in the use of a language with which he is not as familiar as with his native tongue. We hoped for a moment that he might be tempted to use French, in the humorous supposition that all his listeners understood the most polite of all languages. The result of the discussion is some entertainment, some elucidation of a complex matter, but the origin of oil remains a subject for further enlightenment.

SOME WRITERS to the technical Press appear to be unaware of one or two points in journalistic etiquette, and it may be advisable to refer to them briefly. Anonymous communications cannot be printed; even a pseudonym must be accompanied by a letter acknowledging the identity of the writer. When a manuscript is submitted for publication to one journal it must not be offered to another; until a reply is received from the first editor the article submitted is in effect under option to him. A miner who has given an option on his claim to one speculator will not give another option to another speculator until the first option has expired or has been released. A manuscript is as much a piece of property as a prospect-hole, and occasionally is more valuable. If a writer sends a copy of his article to more than one journal he should notify the recipients, who, in most cases, would not then care to publish it, unless it proved of such rare interest as to warrant duplicate publication. Permission is rarely refused to the author to reprint his article after it has once appeared in print, and in most cases the editors of technical journals will lend the illustrative blocks and afford other facilities for doing so. Apart from the morality of giving or selling the same thing to two persons, the duplicate

publication of a technical article is objectionable because diverse versions thus become available. One of these may be carefully edited; the other may be an unrevised edition. If the article should prove important any references to it in technical literature would become confused by the existence of two unlike versions.

ATTENTION has been focussed on the responsibilities of directors by a suit brought by a shareholder in the Trust Company of the Republic against two directors, Messrs. George Gould and Herbert Satterlee, for the recovery of sums of money lost by the Trust company through loans made to the notorious Shipyard Trust and to the president of the Trust Company itself. A decision by the Supreme Court appears to take a lax view of the responsibility assumed by directors and seems to approve of one man, for instance, holding 40 directorates at the same time. The Court says that "directors generally are not supposed to have a knowledge of the details of the business management of the corporation which are not submitted to them. If they are compelled to supervise the details of the management of each corporation in which they are directors, or if they are deemed to have constructive knowledge of such facts as would be acquired by such supervision, it would be wholly impossible for them to accept such a trust," and the Court holds that anything that would lead to the loss of the services of such men would be "little less than calamitous." We are declined to discount the calamity and to place a premium on a keener sense of personal responsibility. It is manifestly impossible for any man to exercise efficient supervision over the affairs of 30 to 40 enterprises. As a director he is a trustee for the shareholders, to whom he should give faithful service. This may be a Utopian view of the director's function, but it is one that we do not despair of advocating, believing that it is also one on which public opinion will eventually insist successfully.

THE BATTLE of the processes has been nowhere waged more vigorously than in Colorado, where chlorination and cyanidation have competed with varying success during two decades for preference in the treatment of the ores of Cripple Creek. Cyanidation is the victor, for it has been apparent for several years that the application of tube-milling and cyanidation to the tailing from the chlorination plants had placed these in a humiliating position. Chlorination became a triplex process, involving the successive application of chlorine gas, concentrating devices, and cyanide solution. Meanwhile cyanidation had evolved as a direct treatment, after roasting of the crude ore. For a long time the big battalions of capital were on the side of chlorination, the principal plants using the process being consolidated in a corporation capitalized at £2,500,000 and known as the United States Reduction & Refining Co., which must not be confounded with the smelter trust, called the American Smelting & Refining Co. or its chief rival, the United States Smelting, Refining & Mining Co. The Standard mill at Colorado Springs, the last of the chlorination plants, has just been closed-down, leaving cyanidation in undisputed possession of the field. The Portland Gold Mining Company has recently changed its mill to cyanidation and the successful plant at Stratton's Independence is, of course, the most up-to-date exponent of the cyanide process. The mill trust has now four chlorination mills on its hands, besides a plant for using zinc-fume in manufacturing paint, all of which are idle. These originally cost £300,000, or, if we include the Metallic Extraction plant, about £400,000, against which stocks and bonds were issued for £2,500,000. No assets remain, save the residue discarded in the heyday of chlorination, now only a memory.

THE SERIES of articles in *The Times* describing the copper mining and smelting enterprise of the Tanganyika Concessions affords an interesting example of the use of newspaper publicity. But it appears to us extremely maladroit. At the head of each article it is stated in italics that the writer accompanied Mr. Robert Williams "at the suggestion of the Advertisement Department of *The Times*" and that "the expense of the publication is borne by the Tanganyika Concessions, Limited." The articles are unsigned and therefore of no technical value, although affording an interesting outline of an enterprise having many and diversified features; and they do not take the place of actual information concerning the present position of an affair in which so much money has been sunk. These articles, however, do one thing, which we recognize with pleasure. They bring out the fact that the mineral exploration and commercial development of Central Africa owes much to the unbounded energy and invincible optimism of Mr. Robert Williams. While we may be sceptical as to the success of the present Tanganyika undertaking, we do believe that the great orebody in the Congo Free State will eventually become the basis for a large and profitable enterprise, and that it will prove a pioneer in opening up a large tract of African territory. Mr. Williams reminds us of the late William C. Greene, who started the Cananea copper enterprise, and was a real pioneer of industry both in Arizona and Mexico. He was not nearly as well educated a man as Mr. Williams, indeed he was of a much coarser fibre, but he was like him in energy and persistence, and he was like him in one fundamental failing, namely, not knowing any limit to his scope, so that he undertook to decide technical questions for which he was not equipped, and therefore avoided engaging the services of first-rate technical men. What is true of the Greene-Cananea is true of the Williams-Tanganyika.

Emmons Memorial.

A committee has been formed by some of the friends of the late S. F. Emmons to collect funds with a view to creating a memorial, to take the form of an endowment for a research fellowship in economic geology at Columbia University. The treasurer is Mr. B. B. Lawrence, at 60 Wall Street, New York. The statement of these facts should be enough to prompt contributions in support of so worthy a purpose. Any mining engineer who is ignorant of the great service done to geology and to mining by the life-work of Emmons is not likely to be impressed by anything we could say; to those who know, any panegyric is supererogatory. The geological record contains the names of greater scientists than Emmons, but it contains the name of no man who did so much to apply geology to industry. What economic geology in America especially, and also in its worldwide application, owes to him would be expressed by a sum of money large enough to endow a great university. It is not desired to do anything grandiose but to create a useful memorial in a university honourably prominent as an exponent of technical education and one to which Emmons was tied by many silken cords of friendship. We commend the proposal to our readers. Write to Mr. Lawrence and send him your subscription.

Eileen Alannah.

This romantic name has been given to a flotation of which it may be said that it illustrates one, at least, of the factors that have discredited the Rhodesian mining industry. The prospectus is marked by an optimism inconsistent with the experience of gold mining either in Africa or elsewhere. The reports are by two engineers of acknowledged repute, Messrs. A. H. Ackermann and Leopold Weill. It appears from the prospectus that the mine is capitalized at £500,000 in £1 shares, of which 250,000 are allotted to the vendors in

part payment and 160,000 are issued at 22s. 6d. to the shareholders of three affiliated Rhodesian companies. Mr. Weill gives no estimate of ore in reserve. Mr. Ackermann estimates 148,229 tons at 13·6 dwt. gold per ton, which on the assumption of an 85% extraction and a working cost of 17s. 6d., will leave a profit of 31s. 6d. per ton, or a total of £223,460. On the evidence available this estimate is sanguine. Some of "the blocks cannot be described [so says Mr. Ackermann himself] as fully developed." A later cablegram from this engineer increases the estimated reserve to 174,824 tons, including 15,000 tons probable, averaging 13·5 dwt. per ton, so that the estimated profit is raised to £262,000. It is acknowledged that the ore is refractory in depth and that "a large proportion [of the gold] has been found to pass away in the slime," hence it is advised that the mill be shut-down pending further development of the mine, with a view to ascertaining the real character of the ore to be treated. Obviously therefore the flotation of the company is premature. But we question whether further work in the mine is necessary to ascertain the proper method of treatment. That has been done by the Cam & Motor management, into whose territory the Eileen Alannah lode passes on its strike. Moreover, the working cost of 17s. 6d. contrasts with 23s. given by the engineers of the Cam & Motor. The higher figure is unlikely to be the less accurate. Again, experience shows that only about 80% of the working 'profit' at a mine finally reaches the shareholder in the shape of dividends. This is a point often overlooked by engineers and directors, not to mention the simple shareholders. Let the reader compare the total 'profits' as announced by the mines of the Rand, for example, with the dividends paid in the same year. Thus even if we take the £262,000 of estimated profits, we must make deductions for an additional cost of 5s. per ton, at least, and for 20% that is absorbed in expenses that do not appear on the books at the mine. In other words, the Eileen Alannah, as at present developed, will do nobly if it yields dividends, not illusory profits of any kind, but real money, amounting to £200,000. But Mr. Weill estimates that "an outlay of £140,000 will be sufficient to develop the mine, equip it with suitable reduction plant, and bring it to the producing stage." To erect a £140,000 plant to gain £200,000, that is, to treat a reserve that would supply the mill for 30 months, at a resulting final profit of £60,000, is manifestly ridiculous. As against this we have a market valuation, on the shares issued, of £460,000. It may be supposed therefore that the mine has good prospects; in other words, that it is an expanding enterprise. Here we are bound to say that we marvel at the lack of acumen exhibited by the promoters in issuing a longitudinal section of the mine which shows clearly that the length of profitable ore is 720 feet on the first level and only 400 feet on the fourth; it shows also that the orebody is pitching flatly into the adjoining claim, the Good Shepherd, which belongs to the Cam & Motor company. At the same pitch the orebody will probably have passed over the western boundary within 400 feet. This feature is illustrated on the so-called 'block-plan,' but it is not made clear in the reports of Messrs. Ackermann and Weill. It is, of course, vital to the enterprise. The drawing that is supposed to show the distribution of ore does not agree with statements in Mr. Ackermann's report and apparently was prepared in London, for it purports to record information contained in his cablegram of October 28. Between June 1 and October 28, the exploratory work, as shown on the map, includes the driving of an aggregate of over 1000 feet, through a block 400 feet long at three levels, yet the estimated increase of ore is only 26,595 tons, that is, 174,824 *minus* 148,229, and this includes 15,000 tons only 'probable.' The additional tonnage increases

the supposed profit by £28,540. Making the necessary corrections, this addition to the profit available, most of it only 'probable,' is about £20,000. Apparently therefore the ground to the east of the older workings, that is, those existing on June 1, is decidedly poor. In any event the manner of giving information is most unsatisfactory and does no credit to those responsible for the prospectus. For the excessive capitalization we do not blame the engineers, who probably were not consulted in the matter. Nor do we criticize them for allowing operating profits to be passed as the ultimate return of money to shareholders; for that we blame an existing system of loose terminology, fatal to technical accuracy or careful business. It remains to summarize the evidence in this case by saying that the Eileen Alannah is not an investment nor a speculation; at £460,000 it is a reckless gamble with big odds on the dealer.

East Rand Proprietary.

The report of the commission of inquiry was published on November 18 and at once made it clear that our anticipations were correct. The analysis of the position as stated in the October issue of this magazine has been amply confirmed. We then summarized our views by saying that "up to date the capacity of the mines, mills, and the management, of the East Rand Proprietary has been overestimated by about 25 per cent." An ambitious programme broke down; to avoid confession of failure the returns were falsified; and a pitiful series of 'irregularities' was committed in order to postpone the inevitable exposure. The tale of a loss of gold in the cyanide plant proves to have been merely the attempt to drag a herring across the trail of gross mismanagement. On November 24 the two directors representing the Central Mining group resigned, and on November 28 the rest of the board announced their intention of offering their resignations at a general meeting of the shareholders called for February 28, on which date a full account will be rendered. In the meantime the urgent need for a stronger man at the head of the technical department has been met by the appointment of Mr. H. Ross Skinner, formerly manager and now consulting engineer to the Durban Roodepoort mine. This does not belong to one of the big groups, Mr. Skinner representing the Donald Currie interest, if anyone in particular. As a matter of fact he is as nearly an independent practitioner as can be found on the Rand, and will be remembered as the representative of the Chamber of Mines who went to China to investigate coolie labour before its importation into the Transvaal. It will be fortunate if the administration of the East Rand Proprietary can be rendered quite independent of market influences, which, after all, are, not unreasonably, supposed to be at the bottom of most of the *vernukerij* that has undermined public confidence in the mining companies of the Rand. The fiasco has opened the eyes of shareholders generally to the possible dangers incidental to group control and the extraordinary irresponsibility that may be exhibited by men holding positions of great trust. From a technical point of view some of the blunders made at the East Rand are obviously of an elementary character. Any superintendent in charge of a prospect-hole and a 10-stamp mill might be ashamed of committing the errors that have brought disgrace upon a vast mining enterprise, owning a whole group of mines and mills, all operated on an enormous scale. The estimation of tonnage by rough calculations based on measurement of the mill-residue is out of date. As if automatic weigh-bridges were unknown. The trucks from the mine, on entering the mill, should pass continuously over the platform of a weighing machine, which records the weight of the ore without interrupting its passage to the bins. The increase of tonnage by adding waste, euphemistically termed "ore below the pay-

limit," exhibits one of the last attempts, it may be hoped, to make a record for low cost by milling material that ought to remain in the crust of the earth. The impoverishment of the amalgamating plates that ensued is again a result that was inevitable, for even the veriest tyro in stamp-milling knows that the amalgam on the plates is robbed by passing the pulp of barren rock over them. Apart from these elementary blunders the deliberate falsification of statements as to tonnage, yield, and cost, the withholding of information from some of the directors, and a final explanation involving further useless prevarication, all indicate a complete break-down of management. What was needed was a strong man able to refuse participation in all this futile juggling with facts. It is true Mr. James Morris resigned from the dual management when he realized that affairs were drifting to disaster, but as he both remained silent and failed to influence the policy of the local directors, we cannot absolve him from sharing some of the blame that is placed on Mr. Sydney Penlerick. Every mining company is the better for having on its staff at least one man strong enough to give vigorous opposition to wrong-doing. The engineer unafraid is not necessarily a fussy individual prone to make unnecessary trouble. He is simply a man of unswerving character. Lacking him the big consolidations are dangerous in the extreme. That is one of the morals of the East Rand fiasco. Undoubtedly economy is gained by operating in large units, but the largest unit is not necessarily an economic unit. After a certain point mere size entails lack of control. The individual mines of the Rand are now, for the most part, large properties and big enterprises. They afford ample scope for the ability of any manager. It is imagined that by consolidating four or five big mines it is easy to reduce the cost of operation per ton of ore, but that is not so certain as it appears, if the individual mines have been conducted properly and if each represents an economic unit. What is certain is that the placing of four or five mines, with four or five managers of average ability, under the control of one man, also of average ability, does not tend to greater efficiency. If you make a super-mining enterprise you must find a superman to manage it. The true captain of industry is rare. At the East Rand he was conspicuously absent.

Basic Lining for Converters.

In the course of his lecture on the Copper Queen mine, Mr. James Douglas stated that basic lining had been proved superior to acid lining for copper converters and that the new smelter at Douglas in Arizona would adopt the use of this material. We understand also that Mr. E. P. Mathewson has recently made satisfactory trials at Anaconda. It appears likely that this kind of lining will be generally adopted, although it is only five years since the first successful use of basic lining was made at the smelter of the Pittsburg & Montana Co. at Butte by Mr. W. A. Heywood. It will be recalled that shortly after the Manhès process of bessemerizing copper was introduced, in 1884, it became evident that the silicious lining of the shells was a large item of expense and that it would be a great improvement if a basic or refractory lining could be used, accompanied by the introduction of silica, either at the top or through the tuyeres, so as to provide material for a slag. Experiments were made at the two American smelters that were the first to adopt converting : the Parrot and the Anaconda works, both in Montana. Other instructive trials were made by Mr. August Raht at Pueblo, Colorado. But all of these proved failures. As the materials used in the first attempt are the same as those now employed successfully, it may be asked why it is now easy to do what was formerly impracticable ? The answer is that the converter of today is much larger, so that the proportion of heat lost by radiation is

less, and the grade of the matte converted is lower, hence more heat-units are generated. Incidentally we may say that while the increased dimensions of the converter have been the controlling factor in this development, it is probable that in the latest designs the size has been allowed to exceed the economic limit. After the first efforts no progress was made until, as stated, in 1906 at the Pittsburg & Montana works, near Butte, a trial was made, with magnesite brick, by Mr. Ralph Baggaley. Small water-jacketed converters had been tried in vain, whereupon a large converter was constructed and proved entirely successful. The metallurgist was Mr. W. A. Heywood, who published an account of his operations in the *Mining & Scientific Press* of April 28, 1906. In the meantime the only gain by the new method was in the labour incidental to making a lining for the converter, although experiments in the Washoe smelter, at Anaconda, showed that the life of the acid lining was prolonged when a large quantity of silicious ore was added to the charge in the converter before blowing. Technical descriptions of the experiments made by Messrs. W. H. Peirce and E. A. C. Smith at the Baltimore and Perth Amboy smelters, together with details of the converter designed by them, appeared in 1910 in the *Engineering & Mining Journal*. Since then the process has been adopted in several smelting establishments. For copper ores containing silver the use of the converter is not well adapted, unless modern methods for the recovery of dust and fume are employed. As soon as the white-metal stage is reached, that is, the point at which the molten copper sulphide is formed, the loss of silver in escaping gas is great. Losses of silver in the converter discharge are rarely less than 20% and of copper never less than 5%, and the subsequent recovery of the fume, whether in chambers or bags, is not so perfect as to warrant the risk. Speaking generally, the basic-lined converter is especially applicable to a low-grade matte made from a silicious ore in the blast-furnace. Any silicious material can be used as flux in the basic-lined vessel, whereas the range of ores suited to the acid lining is small. Mr. Douglas's frank statement marks an epoch in copper smelting, and will, we trust, elicit fresh testimony in regard to the use of basic lining in other parts of the world.

Loose Reporting.

Some of our readers may occasionally feel restive at criticisms offered by us on careless terminology and they may be tempted to blame us for placing undue emphasis on non-essentials. We are not without practical experience in these matters and we do not lay stress upon them without good reason. Mining is based on scientific principles; the principles become demoralized by the use of loose terminology. Wrong ideas and incorrect inferences inevitably result from the slipshod phraseology employed by the careless practitioner. We can give an example that has just been brought to our attention. In the first annual report of the Frontenac Consolidated Mines, an English company operating in Colorado, it is stated by Mr. Henry P. Lowe, the managing director, that assured profits can be won by enlargement of the mill, based on successful experiments recently made. To that end an issue of £22,000 in debenture bonds is to be placed on the market, the shareholders having the first opportunity to subscribe. This is done on the basis of Mr. Lowe's report, which is couched in vague phraseology, backed by evidence of an inadequate character. For the purpose of this criticism it suffices to refer to the statement that affords the motive for the new issue of capital. It is asserted that the further development of the mine would result as follows:

6000 tons milled	at $8·35 per ton	$50,100 per month
Cost of production	at $2·83 ,, ,,	$16,980 ,, ,,
Proceeds		$33,120 per month

"Added to this sum of $33,120·00 per month profit would be the monthly shipments of smelting ores, and a charge of 45 cents per ton for smelter freight and charges will fall to be deducted, together with a small charge for amortization of capital in respect of development." No statement having any pretence to accuracy could be more misleading. Note should be taken of the unnecessary decimal and its following ciphers, suggesting an absolute figure not to be burdened by a fraction; also of the delicate detail in regard to amortization of capital expended in development, as if this small item were of any importance in face of the probability of large errors in the preceding estimates. For these are woefully erroneous. Knowing this particular mining district we hesitate to accept $2·83 as the total cost of production, and that hesitation is not removed by reading the itemized data given in the context. This however is relatively unimportant. We come to the ore that is to yield $8·35 per ton. Elsewhere in the report it is stated that $8·35 is the average value of the crude ore as received at the mill. Hence if that ore yields $8·35 per ton the extraction is at the rate of 100%. Having regard to the fact that the process is stamp-milling and concentration, it is unlikely that the extraction is over 85%. But even this is largely in the form of a concentrate, which is sent to the smelter, from which a return of not more than 95% is likely; thus an optimistic estimate would give 95% of 85%, or 80·75%, as the probable extraction. Deducting the estimated cost of production from the assay-value of the ore to be treated, the engineer gets $33,120 as the fictitious 'proceeds.' But the error does not end here; by a mere flourish of the pen he turns 'proceeds' into 'profits' in the very next line of the report. Thus by the careless use of 'average value' and of 'proceeds' he reaches a visionary 'profit' of $33,120·00—note the·00. Of course such fundamental blunders vitiate the entire report, with its estimate of ore blocked out, its milling test, and its forecasts.

While commenting on this case we may direct attention to a radically unwise procedure adopted by some mining companies, namely, allowing the direction of the mine to remain in the hands of a manager identified with the vendors. It is bad business. Any British company about to acquire a mine should act on the advice of an engineer retained in their interest, as was, we believe, done in the case of the Frontenac, but this precaution should be followed by placing the mine in charge of their own engineer, not a nominee of the vendors. The Frontenac directors apparently are not advised by a consulting engineer of their own appointment, but are acting on the advice of a local practitioner whose interest may not be parallel with their own. The procedure is fair neither to Mr. Lowe nor to the English directors. In mining as in other affairs it is well to remember the old Roman maxim: *Caveat emptor.* He who does not is disregarding an elementary rule of sound business.

The Copper Queen.

The lecture delivered by Mr. James Douglas, LL.D., McGill University, on November 23, on the mining and metallurgical developments based upon the exploitation of the Copper Queen mine, was a notable event in the history of our Institution. The mine and the speaker are both known as illustrations of the most dignified aspects of mining adventure, giving the word its old and romantic meeting. None of the fulsome panegyrics of the vote of thanks were required to indicate how much the audience appreciated the magnitude of an accomplishment that made the Copper Queen one of the great mines of the world. *Quorum magna pars fuit*, but Mr. Douglas is the last man in the world to accept, with any sort of pleasure, the credit for the whole performance, which he shared with Lewis Williams, L. D. Ricketts,

John Langton, and George B. Lee. It is rarely indeed that the story of a mine is told in so informing a manner, and we feel sure that it must have been worth many ordinary lectures to the students who sat on the back benches. If some of them murmured "There's the Yankee for you" to the speaker's outspoken comment on British unprogressiveness, as regards the scrapping of obsolete plant, it was because they failed for a moment to appreciate the essential modesty of a great man, whose criticisms were offered more in sorrow than in conceit of his success. It is safe to say that while we as Britishers do not take kindly to the bumptious assumption of technical superiority expressed sometimes by our younger American friends, we accept as a compliment the advice tendered by a Scottish Canadian veteran, whose right to do so is writ large on his own record.

The Copper Queen mine, at Bisbee, Arizona, was based on a discovery made in 1878. The presence of a big orebody was indicated by a prominent outcrop in a ridge of limestone. The orebody first discovered came to a sudden end, but a stringer or leader in the limestone was followed to another large mass of ore, and this led to a series of orebodies distributed within a thickness of 400 feet of Upper Carboniferous limestone. Apparently the copper ore was derived by concentration from the degradation of pre-existing larger deposits of slightly cupriferous iron pyrite, leaving masses of rich ore covered by the ferruginous clay resulting from the decomposition of the pyritic limestone. The continuity of the ore-channel was not appreciated; hence the romantic story of the Irish Mag and its progeny the Calumet & Arizona and Superior & Pittsburg enterprises. As might be supposed, this type of ore deposit, consisting of chambers in limestone connected by ore-bearing fractures, afforded a grand opportunity for the mischievous mining regulation called the Law of the Apex. Fortunately Mr. Douglas and his associates were as wise as they were energetic, and foresaw the possibility of interminable litigation. Therefore at successive stages in the history of the Copper Queen Consolidated they entered into friendly compacts with their neighbours, whereby extra-lateral rights were mutually abrogated. This is an important part of the story. For the rest, we were impressed by the emphasis laid by the speaker on the fact that he and his fellow-operators repeatedly assumed big risks in the spending of money in large-scale prospecting, in the purchase of adjoining territory, and in the scrapping of machinery that became obsolete as the undertaking progressed. This was pre-eminently a feature of the smelting plant. Beginning with a 36-inch water-jacketed blast-furnace, the metallurgical operations grew until for one year, at least, the output of copper was the largest of any single mine in America. Successive enlargements of the plant resulted in a smelter at Bisbee that cost $1,500,000, but when economic conditions necessitated a new plant, built at Douglas, there was no hesitation in scrapping the old one, so that, as Mr. Douglas said, an asset that appeared on the books at between one and two million dollars became worth between one and two cents. No feature of American industrial progress is more marked than the willingness to discard obsolete plant in favour of modern equipment, when it can be seen that the saving will amortize the capital invested. As the lecture will shortly appear in print, we forbear to quote further details. We note, however, the decision to replace the acid lining of converters by basic lining, in accord, we presume, with recent experience at Anaconda and Garfield. The presence of water (up to 0·33%) in copper ingots due to absorption during cooling was a remarkable bit of information. Another was the loss of copper in dust and the ascertainment of the fact that 3 feet per second is the maximum velocity of movement consistent with effective dust-col-

lection. The use of oil, first from Kansas and now from California, was mentioned as conducing to economy and efficiency in furnace operation, but the speaker expressed keen regret that a natural product containing so many valuable ingredients should be squandered, seeing that it was a resource destined to be exhausted. As an illustration of the development of industry, nothing could have been more effective than the lantern-slides exhibiting the growth of the system of transport essential to the mine, from the 18-mule teams of the early days to the railway train of 50 cars each carrying 50 tons of ore from the mine at Bisbee to the smelter at Douglas. Finally the statistics told an eloquent story, showing a total output of 880,000,000 pounds or 400,000 tons of metallic copper, yielding $35,000,000 or £7,000,000 in dividends. The story of the Copper Queen constitutes one of the most notable chapters in the history of mining, and exhibits a combination of pluck, energy, and wisdom rarely conjoined in any mining enterprise.

The Finance of a Mine.

In this issue we close the series of articles contributed by Mr. M. H. Burnham on the principles underlying the finance of mining enterprises. These articles have, we believe, presented an important subject in an original manner; they have been well worthy of careful reading; and they have developed several new points in the economics of mining. It is likely that the mathematical form given to some of the author's ratiocinations has intimidated all but serious students, and we fear that the use of formulas may have led some of the less sophisticated to infer that mining valuation is a precise science. However, that is no fault of the author, for it is obvious that logical ideas can be expressed in the terms of mathematics and are clarified thereby. Mr. Burnham has undoubtedly helped to crystallize several excellent but vague notions involved in current practice, and he might perhaps have made his treatment of them more effective if he had not adopted so severe an attitude toward other members of the profession, while basing too much of his argument on one case, that of the Santa Gertrudis, in which personal prejudice was unavoidably involved. However, the recognition of these two defects in Mr. Burnham's treatment of his subject is not inconsistent with our appreciation of the value of the articles we have published. He has made good several points of paramount importance, not the least of which is the necessity for an intelligent recognition and understanding, by engineers, of the economics of mining finance. Our conviction that aloofness from actual participation in promotion is best both for the individual and the profession does not entail acquiescence in ignorance of the elementary principles of finance; on the contrary, it is plain that an engineer who reports on a mine should understand the purpose to which his report will be put, and thereby give advice that may be not merely academic but applicable to business. The drift of events is all against the sort of detachment that caused engineers at one time to write ornate descriptions of ore deposits on the supposition that such documents could be of any practical utility to a client anxious to make money by exploiting those ore deposits. Engineers nowadays are asked to advise in negotiations; they are expected to correlate facts with finance; they may serve as directors, and thus assume the duties of a trustee. In other words, mining is not a scientific pursuit but a business based on facts as ascertained by scientific methods.

The next point scored by Mr. Burnham is the 'risk-rate,' the recognition of the principle that the investor should expect not only a bank-rate of interest but as much more as will cover the inherent risk of the enterprise. Thus for example, the Goldfield Consolidated, a mine in Nevada that is the most productive in the

world at the present moment, has a reserve of ore so small compared to its annual production that to an investor it assures the return of only a small part of the capital represented by the market valuation ; hence a Consol rate of 3% would be ridiculous ; to cover the essential risk a return of at least 35% is required, or a risk-rate of 32% above Consols, that is, if the mine be valued on the basis of a three years purchase. On the other hand, the best of the Rand consolidations, despite the East Rand Proprietary fiasco, have a life and a rate of production justifying a much lower estimate of risk, thus warranting a return of, say, 5% above the Consol rate. Of course, experienced engineers have always had this idea at the back of their heads, but Mr. Burnham has brought it to the front. It is, for instance, an advance upon the advice, excellent as it was, of Mr. J. H. Curle, who generalized broadly in a demand that a gold mine, with ore in the bottom, should have 60% of its price assured and be able to pay 10% on the capital. That is a test inadequate to cover the wide diversity of risk inherent in precious metal mining. Mr. Burnham's is much better.

Another feature of this series of articles has been the effort to establish a unit for measuring the probability of persistence of the ore-body, or 'shoot-extension.' This unit is called the 'shoot-foot,' meaning the amount of money to be won per foot in depth. While this unit may not be generally accepted, it is obvious that Mr. Burnham's analysis of the conditions determining the ascertainment of this factor is most helpful. It tends to develop the mental concept on which estimates of this kind are based. Like Mr. H. F. Marriott's 'square fathom,' the particular unit selected is not important, but the underlying principle is vital. This applies also to Mr. Burnham's discussion of deferred dividends. It may not be possible to adopt any cut and dried programme, nor to carry out a prescribed formula, but most assuredly it is important that in these matters we should be guided by scientific principles. Such are those submitted by Mr. Burnham. We commend them to the earnest study of the profession. In order to bring the various aspects of the problem before our readers, we have asked other engineers to discuss them in the magazine. We shall shortly publish several contributions on the subject.

Seasonal Variations.

Those who are cognizant of the varying conditions affecting the economy of mining operations are aware that winter and summer, drought and monsoon, rain and snow, variously aid or hinder a mine manager to an extent measurable in dollars and cents, or shillings and pence, per ton of ore. The migration of Kaffirs is a cause of annual perturbation to mine operators on the Rand, the inevitable nature of which is obscured by needless depression when the native goes to his kraal to sow his mealie, as it is by the equally unintelligible elation of bull speculators when that useful duty has been performed and the Kaffir leaves his many wives for another campaign at the mines. When the Alaska-Treadwell closes its 100-stamp mill on Douglas island at the approach of winter because its water-power is congealed by frost, necessitating the operation of only a part of its milling plant by the use of steam, there is a decrease of output that intimidates the speculator who has been a shareholder for a few months only. We note that this recurrent decrease of production is to be obviated by the installation of a hydro-electric plant, but the illustration will serve, even if it be retrospective. In Colorado the shipment of concentrate from a mill near the 'timber line' may be interrupted by the winter snows. In other regions — such as Michigan — transport by water in summer may be followed in winter either by overland freighting or by a total stoppage of outgoing mineral production. In the Malay States the monsoon may interrupt

the winning of tin by flooding the superficial workings of alluvial mines. These and similar recurrent vicissitudes affect the productivity of enterprises repeatedly and regularly, so that any well informed speculator may derive benefit from them, and any comfortable investor becoming aware of them may save himself unnecessary anxiety.

Secretaries.

In our last issue we had so much to say regarding the Camp Bird that we refrained from making any reference to a pleasant incident that marked the recent annual meeting. We refer to the cordial acknowledgment by the chairman, Mr. Arthur M. Grenfell, of a sense of obligation to the secretary of the company, Mr. A. A. Kelsey, for his efficient services. The acknowledgment does credit to both. Unfortunately such public recognition of the good work done by a faithful and intelligent secretary is not as frequent as it should be. Assuredly a just reason for recognition exists often. Those who take even a detached view of company organization in London are aware how much depends upon the secretary. Occasionally he is a mere clerk, of minor intelligence and able to claim nothing better than a bowing acquaintance with practical mining. Often, however, he is a tactful personage, possessed of a wider experience of mining than any director on his board, and keenly alive to the salient factors determining the success of the administration. We know secretaries who have been mine managers, but exercise a diplomatic reserve in exhibiting a first-hand knowledge of essential principles. They conduct a sort of kindergarten correspondence school for ignorant but insistent shareholders. They receive representatives of the Press with courtesy, and dismiss them with alacrity ; in short, they are pivots around which a vast amount of complicated business turns with a smoothness and despatch that almost obscures the essential usefulness of their daily work. Shareholders who read the lucid review of a year's operations as read by an impressive chairman do not know that an humble secretary has carefully prepared the speech. All goes well if the chairman sticks to the text ; but occasionally he breaks from the leash and makes rash statements, which the poor secretary has to reconcile with brutal facts by means of a circular or on the occasion of the next speech, by which time the chairman's stray remarks have come home to roost, and that rare bird, a well informed shareholder, has arisen in the body of the hall to put a question that cannot be evaded. Secretaries must be born humorists, or they would die of chagrin. But, like diplomats, they know how to keep the joke to themselves. It is the secretary who takes himself too seriously that gets into trouble. Not for him to plume himself on his knowledge of mining, however deep ; not for him to show a too intrusive hand in affairs, however necessary he may be. Particularly will he avoid infringing on the duties of the consulting engineer. When, for instance, the secretary of the Golden Horse-Shoe sent a cablegram lately, giving his opinion on sundry technical affairs at Kalgoorlie, he committed an obvious indiscretion. If the Golden Horse-Shoe company has a consulting engineer, that gentleman ought to have called upon the secretary to mind his own business and if the directors had any authority they ought to stop a procedure so entirely improper. That was a capital blunder in company administration. Other secretaries know as much about mining as he of the Golden Horse-Shoe, but they know full well that it is not for them to trespass into the preserves of the consulting engineer or the mine manager. However, such indiscretions are rare. The one quoted serves to emphasize the rarity of them. For it is a pleasant fact that the engineer of a company is apt to find in the secretary a guide, philosopher, and friend. To him he can speak

more frankly than to his directors, to him he can look for support at the board meeting, in him he can find an interpreter to the lay mind of the simple shareholder. To secretaries the mining industry owes a debt which it is our pleasure to record and to acknowledge.

A Fundamental Factor.

Recent episodes in connection with important mines point to the conclusion that the underground operations of a mining company may suffer by reason of the disproportionate interest taken in metallurgical methods, equipment of machinery, the sampling and estimation of ore, the preparation of reports, and the stimulation of the share market. Directors, and the shareholders for whom they are trustees, are apt to appreciate a metallurgical process the cost of which can be stated in shillings and the extraction in percentages; they can admire a plant or machinery that runs without a hitch and is kept in beautiful order; they have a respect, amounting to awe, for estimates of reserves and even for average assays that are stated in refinements stretching to three decimal points; they read reports as schoolboys who peruse French novels that they imperfectly understand; and they write to the financial papers to explain why the shares in which they take peculiar personal interest are too low, having regard to the facts as they comprehend them. Of course, the shareholder is still something of a lamb and he does not yet get as fair a run for his money as he might; but conditions are vastly better than they used to be twenty years ago and the general spread of knowledge on mining affairs has reached even the hidden mental recesses of the man in the street. We congratulate him, but we warn him, and particularly the more enlightened persons who undertake to guide him, that while the eyes of the supposedly sagacious have been fixed on plant and machinery, on reports and quotations, the fundamental factor in mining is being neglected, namely, the finding of ore. Indeed, the next stage, the economic breaking of ore and the cheap removal of it to surface is less considered than the treatment in the mill and the realization on the market. We need to focus our eyes so that we can see how things are done in the dark places underground, to appreciate the first of the sequence of operations contributory to the winning of the metals, and not to give our attention only to the performances on the sunlit surface of things. A mine is made underground. There is the general manager and the consulting engineer, the surveyor and the assayer, the director and the secretary: but economic success depends chiefly on a more humble individual, namely, the foreman, 'shift-boss,' or 'agent.' And as the other gentlemen select good foremen and encourage them to fruitful purpose, in so far they also perform a useful function. As a matter of fact, the foremen, who have immediate charge of the miners and direct them what to do and in which direction to do it, are not an ornate portion of the staff and come in close contact only with their next in rank, the superintendent. Obviously the selection of the right subordinates is of vital importance to the life of a mine, and the superintendent or manager who knows how to make such a selection is fulfilling a large part of his duty. To do this he must himself be a good miner, familiar with underground work, and not unwilling to spend as much time below the surface as in his chair at the office. Thus we come to the point on which we desire to lay emphasis: that in the haste to improve the other departments on the upper floors of the mining structure we have tended to neglect the essential importance of the fundamental portion—the ground-floor, as it were, of the many-storied edifice constituting a large mining enterprise. We need miners and metallurgists, accountants and secretaries, directors and brokers, but we need first of all the man who can find ore and then extract it cheaply.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

Mining and Politics.—The great mining district of the Rand has within the last week been inspected by many country members of the House of Assembly. The Johannesburg Town Council, the Chamber of Mines, and the people of Johannesburg generally, did their best to show the legislators all there is worth seeing in and around Johannesburg. The mining industry is regarded with suspicion by many members of the House of Assembly. The idea that it is an enormous unscrupulously managed business seems to prevail in the minds of many of the present Government party. The wonderful progress made within the last 25 years is not fully realized. At the present time about 24,000 whites and 200,000 natives, earning altogether about £12,000,000 per annum, are employed on the mines of the Transvaal. These mines at the present time are worked on a sounder basis than ever before, with the consequence that the mining population is becoming more settled, as time goes. A mining life is after all, even to the keenest operator, not an ideal one, and it is noticeable that throughout all classes of the community there is a growing desire to invest money in land. The result is that the price of good farming land is rapidly increasing. South Africa has a great future as an agricultural country, and in a short time, with a prosperous mining industry, a large area of farms will be held by men, who have, while employees at the mines, saved sufficient money to enable them to settle in the country. Meanwhile, it is imperative, for the good of South Africa, that the mining industry should be fostered by the Government, instead of being made the object of attack on every possible occasion. The following points were impressed upon the visiting members of the House of Assembly by the Chamber of Mines:

(1) That this is a factory turning out, on an enormous scale, an average value of about 27s. of gold per ton of ore.

(2) That a reduction of the present working cost will ensure the persistence of the industry.

(3) That a prosperous future can be guaranteed by a reduction of indirect taxation and by an adequate supply of efficient labour to the mines.

The Transvaal Gold Mining Estates held its annual meeting recently, at which the chairman was at great pains to contradict rumours in circulation reflecting unfavourably on the prospects of the company. What the unfavourable rumours were the chairman did not state, except that they were "spread apparently by an official of the company on leave," who was not a technical man. Whether the official was a technical man or not, and although himself unable to form any opinion of the prospects of the company, yet it is possible that his information would be gained from other company officials, some of whom would be technical men. From the report it appears that the grade of the mine is falling off. The ore reserve, at the present time, is estimated at 349,339 tons of an average value of about 14 dwt., as against 398,466 tons averaging 16·8 dwt., the estimated figure given in the previous annual report. The value of the ore shows therefore a decrease of about 10s. per ton. In order to maintain the usual profit with an ore of lower grade, it would be necessary to increase the crushing capacity of the plant. This would seem to be the policy adopted, as a tube-mill has been erected, and with the new electric power-station, an increase in the scale of operations may be expected, unless the shortage of native labour prevents it for the time. So far the result of a shortage of native labour has been to decrease the rate of development. The management of the property is in the hands of S. C. Aimetti.

Labour.—The reduction of the working costs and a sufficient supply of efficient labour are inter-dependent at the present time. The increasing high wages paid to the native on the Rand is directly causing the shortage of labour, as the Kaffir can afford to work for a shorter period and spend more time at home. The high cost of labour is militating against a reduction in the working cost, even where intricate mechanical appliances are introduced to lessen the number of labourers required. The tendency is for native labour to go to the highest bidder. The Witwatersrand Native Labour Association, recruiting natives chiefly from Portuguese East Africa, and the recruiting agencies of the various groups cannot obtain an adequate supply. A field has thus be-

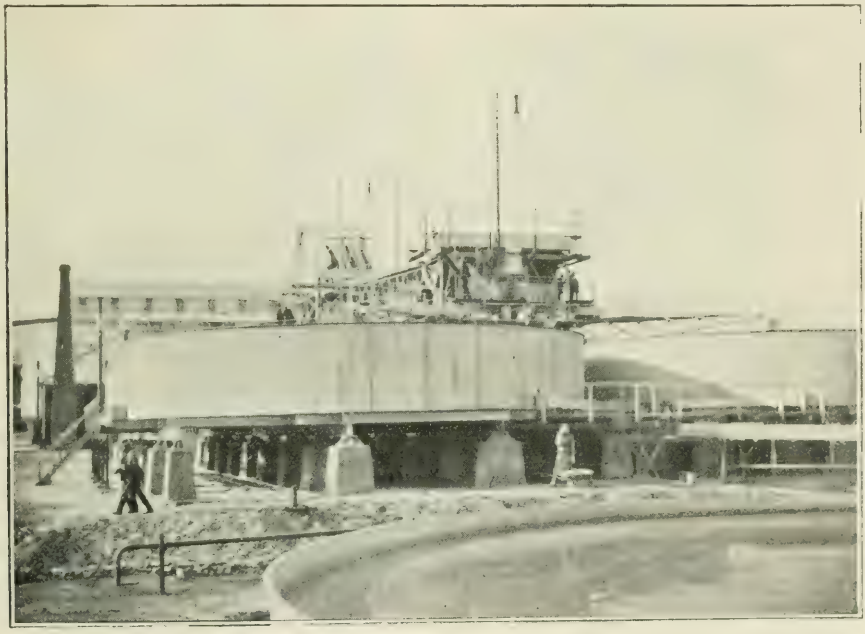
come opened for the private recruiter, who in most cases is a contractor and, as such, takes, for example, a contract to do the shovelling and tramming on a mine, at a fixed price per ton or per truck, a certain proportion of the price paid going to the native and the rest going to the contractor. The contractor supplies his own labour, as well as the candles and other stores required. The result is that both the contractors and their labourers will work wherever the best terms are granted. To obtain the necessary unskilled labour, one mine has only to pay a higher price for underground work than another, in order to obtain a transference of workers. At present about 10% of the natives are in the employ of contractors, whose natives are earning a much higher wage than those of other recruiting agencies. As the percentage of contractor-natives increases, the average rate of native pay will increase also, with the result that the cost of unskilled labour will eventually become prohibitive to any but the highest-grade properties. Mines working at a narrow margin of profit will be frozen out of the labour market. Apart from the question of increased labour-cost, the amount of control held by the contractors over the mining industry is an important consideration, as a strike by the contractors for higher prices would temporarily cripple the entire industry.

The Rand Klip is a mine situated in the far east Rand, where the Witwatersrand formation, consisting of the gold-bearing conglomerates and quartzites, is overlain by the Transvaal system, consisting of dolomite, clay-slate, shale, and sheets of interstratified diabase, the whole containing large quantities of water. The Witwatersrand formation, through which the majority of the shafts sunk on the Rand pass throughout their depth, affords good ground for sinking. On the other hand, the strata of the Transvaal system, containing large volumes of water, are bad for sinking. The difficulties to be overcome in sinking rectangular shafts through this kind of bad ground at the Rand Klip will repay consideration. During the past 12 months, 220 ft. was sunk in the west shaft, which was stopped last January, and 418 ft. was sunk in the east shaft, a total of 638 feet, costing £50,331, or about £79 per foot. Costly experience on the Rand has led to the practice of hoisting in the shafts from one point only. This being so, either rectangular or circular shafts will answer the purpose. A circular shaft is preferable for several reasons. In a circular shaft either the trucks can be hoisted in cages or self-dumping skips used. Where bad ground, containing large quantities of water, has to be penetrated, a circular shaft can be more easily put down and lined with cast-iron tubbing or the system of bricking known as 'coffering,' in such a way that practically all water can be prevented from entering the shaft, obviating expensive pumping arrangements. In addition, future trouble due to the decay of timber in rectangular shafts is eliminated.

The Nissen Stamp was the subject of a paper entitled 'Notes on High-Duty Gravity Stamp-Mills,' by Peter N. Nissen, read before the Chemical, Metallurgical, & Mining Society of South Africa at the October meeting. In this paper the author makes out a strong case in favour of the Nissen stamp, as against the old arrangement of five stamps working in one mortar-box. Theoretically it is natural to expect a stamp of the Nissen type, running in its own mortar-box, to crush more ore, in a given time, than any one stamp in a 5-stamp mortar-box. The Nissen stamp necessarily falls upon an even layer of ore lying on the die, whereas it is easily understood that when five stamps are falling in quick succession in the same mortar-box, a wave motion of the pulp is set up and stamps may drop upon the dies without doing useful work. Apart from this, the Nissen stamp working in its own mortar-box has a larger relative screen-area than is afforded by a multiple-stamp mortar-box of the single-screen type. Mr. Nissen very truly states that the efficiency of the gravity stamp-mill depends "in a great measure upon the skilled attention devoted to it." He also states that in large installations of Nissen stamps it has been possible to obtain an actual running time of over 95% of the total possible time. This is no improvement over the old installation, where five stamps are running in each mortar-box, since the Ferreira stamp-mill of 120 stamps, in the year 1910, headed the list with an actual running time of 353·7 days or about 97% of the total possible time. "Exhaustive tests have been carried out, with Nissen stamps at 2000 lb. dropping weight, at the reduction works of the City Deep, in connection with tests made simultaneously with a 10-stamp battery of City Deep type." The results obtained were in favour of the Nissen stamp. With a $\frac{3}{8}$ in. screen, the tonnage crushed per stamp per day for Nissen stamps was 36·69 to 37·74 tons, and for City Deep stamps 22·72 to 24·34 tons. The power consumption per ton of ore crushed varied from 2·7 to 4 hp.-hours for Nissen stamps, and from 4·45 to 5·5 hp.-hours for City Deep

stamps. From the tests conducted at the City Deep, the efficiency of the Nissen stamps was found to be 30% higher than that of the heavy type of ordinary stamp. The battery in which the 4 Nissen stamps were mounted was one in which 10 ordinary stamps had been before, and probably the comparison between the two types was therefore not quite representative, for the Nissen would apparently not require such heavy foundations and the width of the frame for the 4 stamps could easily be less. [An abstract of Mr. Nissen's paper appears in our Précis of Technology. —EDITOR].

Power-plant. — The Rosherville power-station, owned by the Rand Mines Power Supply Co., and run by the Victoria Falls Power Co., is one of the largest and most up-to-date of its kind. A noteworthy point is the complete absence of the old reciprocating type of engine. Everything is driven by steam-turbines. Steam is supplied by 24 Babcock & Wilcox water-tube boilers, each capable of evaporating 30,000 lb. water per hour, to steam at a pressure of 220 lb. per sq. in. and a temperature of 350°C. The boilers are fitted with superheaters, chain-grate stokers, and Pratt's system of induced draft, which works on the injector principle. The boiler-feed water is supplied by turbine-driven centrifugal pumps. The condenser air-pumps and circulating pumps are also of the centrifugal type, and are driven by steam-turbines, which exhaust into the low-pressure cylinders of the main turbines. Duff coal is supplied to the boilers from small bunkers arranged above the firing-floors. The main turbines, driving the generators, to which they are direct-coupled, run at 1000 rev. per min. The generators deliver a 3-phase current at a frequency of 50 periods per second and at a pressure of 5000 volts at the machine terminals. There are in all 5 A.E.G. turbo-generators each of 12,000 kilowatt capacity. The air-compressors of the rotary type are driven by direct-coupled turbines running at 3000 rev. per min. and are capable of converting 590 cubic metres of free air per minute to an absolute pressure of 9 atmospheres. The compressors, which are multi-stage, are divided into high and low-pressure cylinders, with inter-stage coolers. There are 4 A.E.G. turbo-air compressors. The electric current at 5000 volts pressure is passed through transformers and is supplied at two pressures, namely, 20,000 volts through underground cables and 40,000 volts by overhead lines. The whole plant, which has only been running for a short time, is doing well; although stoppages occur, it is hoped that, after a time these may be reduced to a minimum. The electric power is supplied at a cost of 0·5617 penny per unit, plus 2% for transformer-losses.



CYANIDE PLANT OF THE ROODEPOORT UNITED MAIN REEF MINE.

CAMBORNE.

Goss Moor. — The working of the first 'paddock' has resulted in a profit being made, but the expenses were exceptionally heavy owing to the initial difficulties inherent to a new plant and to the inexperience of the workmen. The cost of treatment per cubic yard of gravel has so far been about 1s., but Mr. Lush anticipates reducing this figure by nearly one-half when everything is running smoothly. If his forecast proves correct, a handsome profit should be shown in the near future. The black tin produced from this property is exceptionally good, the percentage of metal varying from 73 to 75%; and although that percentage is only slightly higher than the first-grade parcels sold by some of the mines, yet the quality of the tin is much better. Quite recently several tons realized £135 per ton.

Great Dowgas.—This property, situated at St. Stephens in Brannel, on which it is stated £60,000 has been spent, is now being offered for sale by the receiver for the debenture-holders. The surface equipment generally is excellent and the battery and dressing plant have a capacity of 100 tons per day. This is yet another of those lamentable examples of erecting a dressing plant before the developments warranted such expenditure; but now that the money has been spent, an excellent opportunity presents itself to anyone willing to put up money to develop vigorously the property, for it is one situated in a good district, and fully deserving a proper trial.

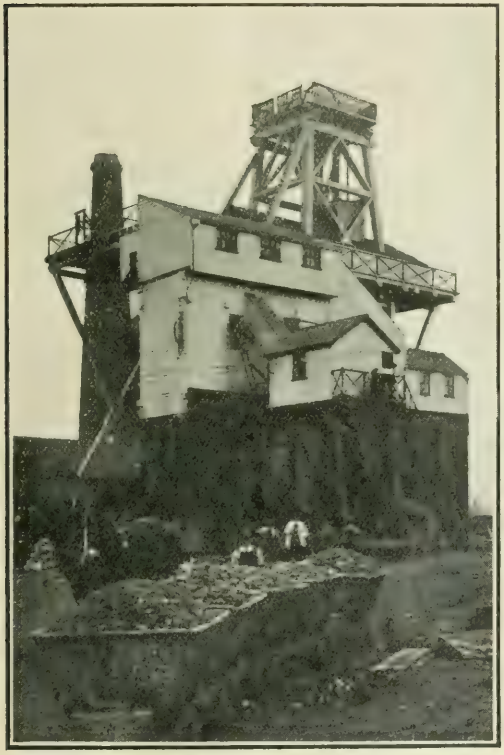
St. Ives Consolidated.—This company is in want of further funds to develop the St. Ives Consols and Giew mines and to equip the former with a mill and dressing plant. An issue of £120,000 6% first debentures has been authorized. William Thomas, of Camborne, has recently made an inspection of the properties; he reports that the St. Ives Consols mine has been drained to the 77-fm. level and he estimates that the ore reserve available is fully 50,000 tons of an average value of 23 lb. of tin oxide per ton, or just over 1%. At Giew, the eastern portion of the mine has been drained to the 122-fm. level in Frank's shaft, and here too, extensive blocks of low-grade ore are available, which he estimates at a further 50,000 tons of 1% stuff, although the local manager figures on 52,000 tons of an average assay-value of 20·5 lb. black tin per ton. Mr. Thomas concurs with the recommendation of the consulting engineer, F. Dietzsch, to erect a 40-stamp battery at St. Ives Consols working on the principle of graduated crushing by the addition of tube-mills and ball-mills.

South Crofty.—The working of this mine for the first 10 months of the current year shows a clear profit of 10s. per ton milled, assuming the cost to be no higher than in 1910, namely, 21s. 6d. per ton milled, which figure includes depreciation, royalties, and all head-office charges. For the period in question, 52,736 tons of ore has been milled, producing 687½ tons of tin and wolfram, or a recovery of about 29 lb. per ton, while the total value of the products, including arsenic, was £83,276, or 31s. 7d. per ton handled. For 1910, the recovery of tin and wolfram was 27·8 lb. per ton, so that the increased profit is largely due to the higher prices realized for the products. With an improved recovery of slightly over 1 lb. of tin and wolfram per ton (there being little increase in the value of the arsenic sold), the monetary value of each ton of ore milled has jumped from 25s. 6d. in 1910 to 31s. 7d. for the first ten months of this year. The development footage continues about the same; 4053 feet was developed or one foot for each 13 tons of ore sent to the stamps, which is a fair rate considering the width of the lodes.

Dolcoath.—The interim dividend recently declared by the directors, of 1s. per share, free of income tax, on account of the profits for the current six months, absorbing £17,000, makes it quite evident that the working cost at the premier mine of the county has been materially reduced, for otherwise a profit to justify such a dividend would be out of the question. For the 19 weeks ended November 11, 34,495 tons of ore was crushed, producing 636 tons 8 cwt. of black tin, which realized £74,355. The recovery is equal to 41·3 lb. per ton, and the recovery per ton was worth 43s. 1d. or slightly over 1s. per lb. For the six months ended June 30 last the recovery was 47·38 lb. per ton milled and the value 49s. 7d., so that the monetary value has fallen 6s. 6d. per ton. The working cost for the previous six months, including depreciation, but excluding income tax, which is only charged once a year, was close to 34s. 6d. per ton. If the working cost for the current half-year is taken at this figure, the profit for the first 19 weeks would be £14,800, or 8s. 7d. per ton, but seeing that the dividend declared absorbs £17,000, it must be obvious that the manager's anticipations of a reduced working cost, resulting from the completion and use of the Williams shaft, of the approved stamping arrangements, and the many surface improvements, have been fulfilled.

From a recent Home Office report, it appears that Dolcoath, as might have been ex-

pected from the interest shown by R. A. Thomas in the health of the miners, has taken the lead in the provision of baths for the men. The bath-rooms are 7 ft. 6 in. by 5 ft. 6 in., and each is partitioned off and fitted with an enamelled bath, hot and cold water being provided. For a preliminary washing of the hands and face, basins have been installed. It appears that on an average the men have a bath once a week, but they may have one daily if they so choose.



Robinson Shaft, South Crofty.

Labour-Unions.—It is common knowledge that labour-unions have not in the past been regarded with any favourable eye by the miners and clay-workers of Cornwall, all efforts to organize the men having resulted in miserable failure. Now, however, it appears that the Workers' Union, in consequence of an active crusade, is getting a hold on the clay-workers of Mid-Cornwall, and an extension of the movement to the Mining Division is promised in the near future. The bait held out to the clay-workers is a minimum wage of 30s. as against about 20s. per week. There can be no question, considering the prosperity of the china-clay industry, that the wage of the average worker is inadequate and miserably small, and with the advance in the cost of living, the men are justified in expecting a higher rate of pay, but the 50% increase, which is the ultimate aim of the Workers' Union, is quite out of the question. It would be a wise move on the part of the proprietors to anticipate the growing irritation of the men by advancing wages, and this too would be the best plan to counteract the wiles of the Union officials. It is to be hoped that the miners too will not be led into any agitation for an increased minimum wage irrespective of work done. Owing to the increase of men on day's pay, the possibility is certainly not so remote as formerly, if a really well organized effort were made to enrol the men in the Union. But with so few of our mines making profits at the present high prices, any such agitation would be most inopportune, and if successful, could only result in the shutting-down of some of the concerns that are now struggling to make both ends meet.

SAN FRANCISCO.

Interest in Mining upon the Mother Lode has been much stimulated by the transfer of the Old Plymouth Consolidated mine, in Amador county, to Bewick, Moreing & Co., late in October. The mine has been idle for nine years, and is now full of water. The property, which was worked continuously until 1888, is reported to have made a total production of $6,500,000 and was a consolidation of the Empire, Amador Pacific, and Plymouth mines. It was equipped with two 80-stamp mills, one having 750-lb. stamps and the other 1000-lb. stamps, driven by hydraulic power. The average yield of the ore in 1886 was $6·18 per ton, and $7·59 per ton in 1887, the working cost being given as $3·07. The concentrate averaged 1½%, and is reported to have had a gross value of over £100 per ton. It was treated at the chlorination works of the company at a cost of £13·40 per ton of concentrate. The vein was 40 to 70 ft. wide and dipped 57° to the east. The main ore-shoot was 400 ft. long. The mine was opened by three inclined shafts and one vertical 3-compartment shaft 1700 ft. deep; it was comparatively dry and buckets were used for bailing. In 1888 a fire broke out in the mine between the Pacific and South Empire shafts, and was only extinguished by sealing up the mouths of all the shafts. When the mine was re-opened, it was found that the workings had collapsed in several places and after a small amount of desultory work, it was finally closed in October 1892. Albert Burch is the local repre-

sentative for Bewick, Moreing & Co. and the work of development is already under way. The results will be awaited with much interest. Another old mine that will probably soon be re-opened is the Princeton, in Mariposa county. This is reported to have produced over $5,000,000 and has been worked to a depth of 1250 ft. (vertical) though the larger part of the production came from above the 600-ft. level. The chances that both of these mines can be developed into large and profitable producers are generally regarded as excellent.

At the App mine, at Quartz, in Tuolumne county, the surface of the Heslop claim collapsed (on October 28) over an area 150 by 200 ft. The penstock to the mill was broken, but little other damage was done, though the caving (due to insufficient timbering) extended through to the 300-ft. level.

Dredge No. 8 of the Natomas Consolidated was destroyed by a fire on October 20. This dredge and Natoma 9 are peculiar in utilizing electric current at 2000 volts. The fire appears to have started in an oil-switch (not transformer), and as soon as it was realized that it was beyond control the sea-valves were opened with the intention of sinking the boat. Unfortunately the digging-ladder prevented the bow from sinking, and the accumulated tailing prevented the submergence of the stern. The part that remained above the water was completely destroyed, but some of the machinery will undoubtedly be salvaged. The cost of the dredge is given as $250,000 and it was insured for about ⅔ of that sum.

The report of the Utah Copper Co. for the quarter ended September 30 shows an increase in production, as was anticipated, and the lowest cost per pound in the history of the company. The output for the three months was 25,851,456 lb., as compared with 25,469,812 lb. for the previous quarter and 21,296,709 lb. for the first three months of the year. The net average cost for the quarter, after deducting smelter allowances and without crediting miscellaneous income, was 7·56c. per pound, while in September it was reduced to 7·18c. for the monthly average. The cost during the previous quarter averaged 8·02c. per pound. The company made a net profit for the quarter of $1,538,712, including $375,187 Nevada Consolidated dividends. It paid $1,177,012 dividends and added $361,700 to surplus. The ore handled showed a falling off in grade, being 1·4829% copper, as compared with 1·6332% copper for the previous quarter. The tonnage was increased from 1,060,414 to 1,273,373. The earnings for the quarter were $361,700 over the dividend requirements, corresponding to a surplus over dividends of $554,000 for the first nine months of the year.

MEXICO.

Restoration of Order. — Francisco I. Madero, leader of the revolution that overthrew the Diaz government and now president of Mexico, has announced his intention of taking energetic action for the complete pacification of the country. He states that bandits and those who rise in arms against the general government will be crushed with an iron hand. He has ordered a vigorous campaign against Zapatistas in the State of Morelos, and has sent a force of federals to crush an uprising in Oaxaca. The Chamber of Deputies has passed a bill appropriating 14,000,000 pesos for increases in the army, the greater part of the money to be spent in the organization of additional regiments of *rurales*. When the provisions of the measures are carried out, there will be 60 regiments of *rurales* in the service of the Mexican government. Conditions still are unsettled, and some fears for the immediate future are entertained. Gen. Bernardo Reyes, now at San Antonio, Texas, is believed to be planning a revolution against the Madero government, and his movements are being watched by secret-service men of both the American and Mexican governments. The American government is taking steps again to patrol the border effectively. In Torreon several thousand workmen are on srrike, the number including the employees of the Torreon smelter, which is controlled by the Madero interest. The strikers demand increased pay and an 8-hour day. The city has been placed under martial law. It is feared that workmen in other districts will follow this bad example.

New Railroads.—The Southern Pacific has commenced surveys for a line from Guadalajara to Mexico city. A concession for such a line was granted by the Diaz government. The West Coast extension of the Southern Pacific will be completed to Tepic, capital of the territory of the same name, in December, and it is announced that there will be as little delay as possible in building the link between Tepic and Guadalajara. The National Railways of Mexico recently borrowed $13,000,000 from New York bankers, and a part of the money will be devoted to the proposed Tampico-Veracruz and Tampico-Mexico City lines. The Tampico-Vera-

cruz line will traverse the oil belt of the State of Veracruz, where there has been great oil development during the last 18 months, and will also open a rich agricultural territory. A branch will be built to connect with one of the National lines in the State of Hidalgo, thereby establishing a short route between Tampico and Mexico City. Work on the Durango-Cañitas line of the National, which has been delayed by a shortage of money for construction, is to be pushed This line will open the Sombrerete, Nieves, and other mining districts. The Mexico Northwestern Railway is operating trains on the recently completed branch that gives facilities of transport to the Cusihuiriachic silver district of Chihuahua.

Smelting Resumed. — The Chihuahua smelter of the American Smelting & Refining Co., which was closed several months ago as a result of disturbed labour conditions following the revolution, is again in operation. The company will build two additional furnaces at this plant, giving it a capacity of from 900 to 1000 tons daily. Smelting also has been resumed at the 600-ton copper smelter of the Rio Tinto Copper Co. at Terrazas, in Chihua-

MADERO'S TROOPS ON THEIR WAY TO THE REFUGIO MINE, AT SALINAS.

Oil.—A bill placing oil land on the same basis as mineral land, giving every one the right of prospecting and denouncing, has been introduced in the Chamber of Deputies by Congressman Jose Maria Lozano. The bill seeks to guard against monopolistic control by the purchase of oil land, as is possible under the existing laws. At the introduction of the bill Congressman Lozano said: "A sale of the Pearson oil interests to the Standard Oil is now pending, and if we do not pass this bill a time will come when the old Viceroy's palace and the castle of Chapultepec will be ruled from Wall Street, as the Standard Oil money will buy the votes, the magistrates, the courts, the deputies, the senators, and the presidents. I want to keep Mexico out of reach of the golden arms of the ferocious octopus." The bill provides for taxing oil land, as mineral land now is taxed, and provides for a tax on all oil exported from Mexico. Recently there have been reports of negotiations between the Pearson interests and the Standard Oil.

hua, which likewise was closed some time ago as a result of disturbed conditions. The Rio Tinto is controlled by Cleveland interests.

Mololoa.—This famous old mine, in the Hostotipaquillo district of Jalisco, is again producing rich ore, and shipments are being made regularly to the Aguascalientes smelter of the American Smelting & Refining Co. Two hundred pack-mules are on the road between the mine and the Southern Pacific Station at Magdalena. The Mololoa is now the property of the Mololoa Mining Co., of New York, which purchased it early this year. It formerly was owned by the Mololoa syndicate of Toronto, Canada. Recent development has shown that the Canadian concern was within 30 ft. of a bonanza when work was

stopped because of lack of capital. The New York company will build a reduction plant during the coming year, a big tonnage of high-grade milling ore existing in the old and new workings.

Greene-Cananea.—The October production of this big Cananea concern was 6,000,000 pounds of copper, the largest in the history of the Cananea smelter. About one-third of the output resulted from concentrate from the Miami Copper Co., which are sent from the United States to Cananea for smelting. It is stated that the production cost of the Greene-Cananea is being held to 9 cents per pound of copper.

Dos Cabezas.—Dr. F. S. Pearson and associates will build a stamp-mill and cyanide plant at their Dos Cabezas mine, 60 miles west of Casas Grandes, in Chihuahua. The greater part of the reduction machinery has reached the property. The Dos Cabezas has been producing rich ore for some time; a recent shipment of 27 tons to the El Paso smelter netted $18,000. The Mexico Northwestern railway, which is controlled by the Dr. Pearson interests, recently let a contract for a 47-kilometre branch, to extend from Pearson to Colonia Pacheco. This branch will give transport facilities to the Dos Cabezas.

MELBOURNE.

Mining in Australia during the past month has been uneventful. The truth is that the people generally are so prosperous that prospecting has been almost entirely suspended in order that labour may devote itself to the more lucrative avocations of agriculture and shearing. This condition of affairs has prevailed for the past seven years and is reflected in the declining gold yields in all the states. That for Victoria has sunk to 432,000 oz. for the first ten months of the current year, a shrinkage of 50,000 oz. as against the corresponding term in 1910. The other States, even though they do not disclose much decrease, have the shaky appearance that presages a fall. It is evident that the developments in mining for the future must come from the vast belt of country that lies inside the fringe of settlement around the coast. To go inside that fringe means exceedingly hazardous work and for the moment no one is inclined to accept the risk. When times become hard and labour is less exacting, then prospecting will be resumed and Australian mining will go ahead again.

In North Queensland the Mount Elliott mine has given a record yield for a month. The October campaign resulted in 606 tons of blister copper being obtained. This is the best record of the mine, but strange to say it was prefaced by a substantial drop in the price of the shares. This is ascribed to the shortage of labour in the district and to the fact that the ore in the bottom level is not developing satisfactorily. Diamond-drilling gives little result. A new claim, the Limestone, in Cloncurry, has been acquired, and it is hoped that this property will revive the fortunes of the company. The old estimates of £35 per share strangely compares with the price at the present time which is practically one-tenth of that value. Great expectations continue to be centred on the Hampden and Duchess mines belonging to the Hampden company. A large smelter is being built, and when this is in operation a livelier market for the shares is expected to result, due to the better working conditions that will then prevail. By that time also the Duchess mine will have been linked by railway with the Hampden, and the company's new claim, the Trekelano, should also be supplying a quota of the smelter charge. All the same the feeling is that it would be a great deal better if the Mount Elliott with its substantial cash resources and the Hampden with its orebodies could be consolidated into one property with a central concentration plant. There seems to be some jealousy over the solving of this problem, but the difficulties may be overcome and a fine mineral district of great extent helped by such a combination.

Broken Hill.—So far the British Broken Hill mine has failed to locate the upward continuation above 200 ft. of the big shoot of ore discovered at Thompson's shaft. The orebody may have turned away flatly to the south, and if so the delay in picking up the lode can be easily understood. Boring has been carried out on a large scale to find the shoot of ore in that direction. The company has declared a dividend of 2s. per share from profits made partly out of mining work and partly out of the sale of slime to the Junction North.

The Labour Strike at Mount Lyell continues. It constitutes one of the most interesting labour ebullitions south of the equator. The attitude of the mine employees in upholding the case of Norman White who went into the mine to terrorize two contractors into admitting that they had been working more than eight-hour shifts has created a bad impression, for it is taken that the real motive of the leaders was to claim for themselves as Union officials the right to go anywhere they like in the pro-

perty. As the Lyell Blocks next door is trying to pick up the shoot of ore supposed to underlie from the North Lyell into the Lyell Blocks, it can be seen how detrimental to the company, even from the standpoint of hard business considerations, it would be to allow men not under the discipline of the company to go wherever they please in such a claim as the North Lyell. This by no means indicates that the Lyell Blocks is likely to pick up the North Lyell shoot of ore, and I only mention the matter to show how from a working standpoint no management could concede to an irresponsible body of trade unionists the right to move about where they like in a mine at their own sweet will. The present position is that the man Norman White is likely to be thrown over-board by the unionists, and the company may agree, in order to retain workers at Mount Lyell, to discuss the question of an increased wage to its employees. Looking at the profits for the past twelve months it seems difficult to see how the board can afford to give any great increase in wages, unless the price of copper improves. With this fact staring the public in the face, the general impression prevails that the strike is not so near settlement as some people estimate unless the men can be brought to realize the exact position of affairs.

Northern Territory.—A great deal of amusement has been caused by the receipt here of a circular telling of the coming boom in 'Northern Terrors.' When we in Australia are informed that the Northern Territory is the richest goldfield in the world, we only wish to goodness that such was the case. If that were so, then, instead of the Australian gold yield dwindling, it would be on the up-grade, and we should have a greater output of the precious metal than is produced at present on the Rand. The statement that Palmerstown is the principal town is a bit of geographical news to people who had hitherto ascribed that honour to Port Darwin. It is not generally known that one of the largest holders of town properties there is Lord Rosebery, and that the Federal Land Tax has been specially designed to reach absentee squatters of his type. Allowing that all the figures given in the circular respecting the output from the properties held in the Northern Territory goldfields be perfectly true, even then they only represent scratchings. It would be a slur on the mining intelligence of Australians who have dipped pretty deeply into Northern Territory shows in the past if they were proved to have neglected the wonderful resources of that country. Australians as a rule are credited with being fairly well versed in the possibilities of gold mining, and had anything like 6-oz. ore been forthcoming on a decent scale in any of the Northern Territory mines the boom that would be created would astonish everyone. As it is everything in the Northern Territory is as dull as ditchwater.

TORONTO.

Porcupine.—The approach of winter has been accompanied by great activity in transporting mining and mill machinery. A large amount of building has been accomplished during the last few weeks, operations having been rushed with all possible speed so as to get everything in shape before the severe weather sets in. The principal interest now centres in the completion of the mills in connection with the leading mines, especially the Dome, Hollinger, and Vipond, all of which are expected to be in readiness to begin operations early next year. The Dome is likely to be the first in the field some time in February. For about a month the crushing operations will be confined to low-grade ore in order to get the stamps in good working order. The Hollinger hopes to get to work in March, while the Vipond management state that February will see their mill in operation. Its construction is of a simpler character than that of its rivals, having tube and pebble mills in place of stamps. The ore will be crushed to 200-mesh before amalgamation and owing to the free-milling character of the ore the cyanide process will not be required until the tailing has accumulated. The McIntyre 10-stamp mill will be installed during the winter. During the last week of October a number of the directors and stockholders of the Dome, including several prominent American financiers, visited the property. Ambrose Monell, the managing director, states that diamond-drill work over an area of 1000 ft. had greatly improved the prospects of the property, proving an enormous body of milling ore in depth, though it was too early to speak positively as to its assay-value, excepting as regards the surface and the 50-ft. level. Of two drifts run at that level, one showed $28 ore for 136 ft., while the gold contents exposed by the other, running parallel, ran from $30 to $40 per ton. Two additional shafts are going down. At the Dome Extension the main shaft has reached 180 ft. Cross-cutting will be done at 200 ft. to cut several northerly veins. On the West Dome three shafts are going down and some cross-cutting has been

done at the 125-ft. level. A mill will be built in the spring. Underground work is being actively pushed at the Hollinger. Connections are being made at the 200-ft. level with the shaft, which will be put down to 400 ft., the main working level. At the Miller-Middleton adjoining, operated by the Timmins-McMartin syndicate, a shaft is down 50 ft. and a cross-cut is being run into the hillside to connect with it. The Crown Chartered, in drifting on the 100-ft. level, has got into pay-ore in a schist and quartz vein at least 50 ft. wide. Some high-grade ore has been encountered. The vein of the Davidson property operated by this company has been cut at depth and shows good milling ore. The main shaft of the Eldorado is down 28 ft. and has encountered numerous quartz stringers. The Dobie is getting in additional mining equipment. No. 2 shaft is being deepened to reach a promising orebody discovered by diamond-drilling. Bert Purrier has been appointed manager of the Rea mine. No. 1 shaft has reached the 300-ft. level and cross-cutting at that level shows the vein to be equally strong as at 200 ft. The Porcupine Reserve is sinking on a quartz and schist lode 75 ft. wide carrying some gold.

Cobalt.—Though the production of silver by the Cobalt mines, and the payment of dividends by the leading producers are well maintained, there is comparatively little interest now taken by the public in this district, and the stock market has been very dull for some time, many of the cheaper issues having disappeared from the list. La Rose has lately improved its position by some good discoveries, including an ore-shoot on the Lawson property 6 in. wide averaging 5000 oz. per ton, and other finds on the Princess and Fisher-Eplett. A statement covering the first nine months of the year shows a total production of 2,751,946 oz., having a gross value of $1,444,271, and shipments aggregating 3,179,985 oz. The income was $1,453,958, the expenses $536,868, leaving an operating profit of $916,765, being an average of approximately $102,000 per month. The Nipissing has recently considerably increased its ore reserves. The high-grade ore is now treated by the Butters plant and it is claimed that with a few alterations in the process low-grade ores can be treated successfully, and that from several thousand tons of low-grade ore accumulated a recovery of 93% or better could be secured at a cost of $3 per ton. In the spring extensive hydraulic operations will be undertaken for the removal of the overburden on the property in the hope of discovering new veins. The hydraulic pump installed for the purpose has been successfully tested. It throws a stream of 4800 gallons of water per minute and has a head of 415 ft. The Crown Reserve has opened up several new ore-shoots. On the 170-ft. level the vein, which was lean, suddenly widened to 4 in. of ore stated to run 6000 oz. per ton. Cobalt Lake has picked up a cobalt vein 100 ft. from the shaft on the 100-ft. level which carries 200 oz. silver and is taking out much ore. The mill is running steadily treating about 75 tons per day. The Temiskaming has passed its quarterly dividend in order to devote the money to the purchase of a controlling interest in the North Dome at Porcupine.

NEW YORK.

Stock quotations, especially on mining shares, are buoyant in spite of the prevailing uncertainty as to future political events. They reflect an underlying activity in nearly all industrial lines. The market for copper and steel is good, being supported more and more strongly by the purchases of smaller consumers. The entire list of mining shares traded on the New York Stock Exchange has recorded decided gains within the past month; for example, Amalgamated, $10\frac{3}{4}$; A. S. & R., $10\frac{1}{2}$; Chino and Miami each, $3\frac{3}{4}$; National Lead, $7\frac{1}{4}$; Tennessee Copper, 4; and Utah Copper, $7\frac{1}{2}$. The behaviour of the United States Steel stocks has been still more striking; during the period of uncertainty, common fluctuated around 55 and preferred around 105: in the excitement following the Government's suit, common dropped to 50 and preferred to 103; but now that the issues are clearly drawn, the market evidently has confidence in the final outcome, for common has climbed to 64 and preferred to 109. To be sued by the Government seems to be good advertising.

Mineral land laws, which for 40 years have been the source of constant irritation and litigation, may be revised in the not distant future. The American Mining Congress, among the several societies whose members are interested in the business of mining, has taken the lead in subjecting the present laws to constructive criticism and in agitating for reform. The present plan of this organization is to appoint a committee to confer with a commission from the House of Representatives, and with the assistance of an advisory board of engineers and mining experts, to

evolve a new code in the light of modern knowledge of the occurrence of ore deposits. It was the lack of this knowledge that was principally responsible for the passing of the law of 1872, which has since proved to be inconsistent and impracticable in many cases. It is an almost foregone conclusion that an essential feature of the new law will be the adoption of vertical planes as boundaries on all sides of a mining property, thus avoiding the confusion that arises from the present allowance of extra-lateral rights. Another commendable feature will probably be the introduction of a stipulation that will make it more difficult for a company to pre-empt a large number of claims and hold them indefinitely by the performance of a merely nominal amount of annual assessment work, without making an effort to develop them into mines. In already occupied mining districts, of course, a large amount of adjusting will be necessary to reconcile the old arrangement with the new. The Mining Congress has the support of the Governors of many Western states and of many members of the national legislature, whence the probability of carrying through the proposed revision is brighter than it ever has been. Your British readers may not understand that the national mining law relates only to the formalities necessary to be followed in obtaining possession of a piece of mining ground situated in the public domain. It has no jurisdiction whatever over the method of operating a mine; under the Constitution, all matters relating to the health or safety of individuals are delegated to the governments of the several States. A federal law analogous to the British Mines Regulation Act would therefore be uninforceable in this country. It is fair to say that most of the States in which mining is conducted have realized their responsibility in this direction.

The Bureau of Mines is likely to be burdened with a wider field of endeavour, at the instigation of members of Congress with Western constituencies. The chairman of the congressional committee on mines and mining has been in consultation with the Director of the Bureau in the drafting of a revised statute to be submitted at the forthcoming session, and certain societies of mining engineers have been invited to offer advice. The alteration most prominently suggested is the insertion of a provision to allow the Bureau to undertake the investigation of processes in ore-dressing and metallurgy; the nominal object of conserving national resources is to be attained by diminishing losses in treatment. The exploration of mineral lands by boring, the abatement of smoke nuisance at smelters, and the development of more economical and efficient methods of mining are also mentioned as proper fields for the Bureau's activities. In regard to work of this character it may be said that if the big operating companies, with self-interest to prompt them, with the most eminent engineers to advise them, and, in many cases, with ample funds to devote to such purposes, are not able to solve these problems in economy, it is exceedingly doubtful whether the Bureau of Mines will be any more successful. The most valuable work now being done by the Bureau is its investigations into the prevention of coal-mine explosions, which it inherited from the Technologic branch of the Geological Survey. It has established thoroughly equipped rescue stations at a number of points throughout the coalfields, and also maintains a number of cars that can be sent by rail at short notice to any mine in need of expert services and life-saving equipment. It has also undertaken to train the more intelligent among the coal-mine workers in the arts of combating explosions, subduing mine fires, and rescuing and resuscitating injured miners. Even these commendable and humanitarian endeavours should be looked upon rather as the setting of a good example to coal operators than the relieving of the states from their direct responsibility for such activities.

Southwestern copper mines continue to develop. Miami is now operating five of the six sections of its mill, and produced 2,000,000 lb. copper during November; this will soon be increased to 3,000,000 lb. per month. The cost is 8·5 cents per pound, delivered at New York. The company is now managing its own sales, at prices averaging 13·25 c. per pound. Negotiations for the sale of the Live Oak mine to the Miami company were about to be successfully concluded when they were abandoned on objections from the Live Oak directors. These then opened another trade with John D. Ryan, who promptly purchased control and a large amount of minority stock, at $30, or about the market quotation. It is rumoured that this is only a forerunner of a wider consolidation under the Cole-Ryan auspices, into which Miami and Inspiration may be drawn. Miami has regularly been shipping its concentrate to the Cole-Ryan smelter at Cananea, Mexico, which, on its face, would appear to be a less convenient arrangement than to smelt at Douglas, Arizona.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

Nov. 1911.	Oct. 1911.	Nov. 1910.
£57. 8s. 3d.	£55. 5s. 2d.	£57. 15s. 3d.

The rapidity with which the world's stocks are being drawn upon has at last arrested the attention of the speculative public. The continued decrease in stocks both in Europe and America is evidence of enormous activity and prosperity. This activity has hitherto been confined to Europe, but the American railways have recently placed large equipment orders and improved conditions are reported from that side. For October this consumption showed an improvement of 3000 tons, and the November figures show an increase in domestic consumption of 2000 tons and in export of 3500 tons. Should American trade continue to follow the European lead, the pessimistic views hitherto held in many quarters as to the baleful effect on prices of the increased output from the new 'porphyry' mines will be revised. Orders held back during the recent political disturbance have recently been placed and the demand has been so active that the leading producers are practically sold ahead for two months. They have continuously raised prices to 13¼ c. for electrolytic. On the Metal Exchange prices rose from £55. 15s. to £60 for 3 months, accompanied by a rapid advance in copper shares. The excitement was reminiscent of the 1907 boom. Every rise in price has stimulated fresh demand and, as early delivery is insisted on, it may be presumed that stocks in the works are low.

TIN.

Average prices of cash Straits tin:

Nov. 1911.	Oct. 1911.	Nov. 1910.
£194. 19s. 4d.	£187. 2s. 9d.	£166. 18s. 0d.

Tin shows a steady advance in price during the month of about £15, and a widening of the backwardation which now amounts to £11 per ton. Dealings under the new contract were introduced on November 1 and the syndicate brokers who are hostile to it have been buying up the available supply of Straits tin, so that the market has degenerated into a record of their doings. Otherwise speculation has been greatly reduced by the high prices and distrust of the syndicate. A good consumptive demand however set in about the middle of the month and assisted the bull operators in Straits tin. A large business was transacted from day to day in the East, but the market otherwise has become entirely professional and artificial especially for prompts short of February 1. The Banka sale realized an average of £208. This has brought out buyers for December prompts who bid up the price to £205, most of the supplies coming from the syndicate brokers, who thus gave the market a welcome relief. Standard tin was also in better demand and the price was raised to £192. 10s. The November statistics show an increase of 2643 tons, just about equal to the Banka taken into stock on the 30th.

LEAD.

Prices of soft foreign lead:

Nov. 1911.	Oct. 1911.	Nov. 1910.
£15. 15s. 5d.	£15. 6s. 1d.	£13. 4s. 6d.

Lead has shown a further advance and at one time £16 was freely paid for spot. Consumption has shown enormous expansion, for which the falling off in production has not prepared the dealers. The strike of Australian wharf labourers, further unrest in Mexico, and the heavy advance in freight rates give rise to a belief in the continuance of the scarcity. Nevertheless demand seems to have quietened down and lower prices will probably be seen in December, when trade usually falls off. Prices are already somewhat easier at £15. 17s. 6d.

SPELTER.

Average prices of spelter:

Nov. 1911.	Oct. 1911.	Nov. 1910.
£26. 13s. 2d.	£27. 4s. 10d.	£24. 1s. 9d.

Prices show little variation. The convention, after the substantial cut last month, has again advanced prices by 5s. Better reports are received from the galvanized iron and zinc-sheet trades. By insisting on buyers purchasing on average, the convention is arousing some dissatisfaction.

OTHER METALS AND MINERALS.

Prices quoted on December 9:

SILVER.—25⅝d. per oz.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£53 per ton.

NICKEL.—£170 per ton.

COBALT.—9s. 9d. per lb.

ANTIMONY.—£28 per ton.

QUICKSILVER.—£8. 2s. 6d. per flask.

MANGANESE ORE.—8d. to 9½d. per unit (1%).

IRON ORE.—Cumberland hematite 19s. 6d. per ton at mine. Spanish 20s. delivered.

PIG IRON.—Cleveland 47s. 9d. per ton. Hematite 61s. per ton.

WOLFRAM ORE—30s. per unit (1%).

DISCUSSION

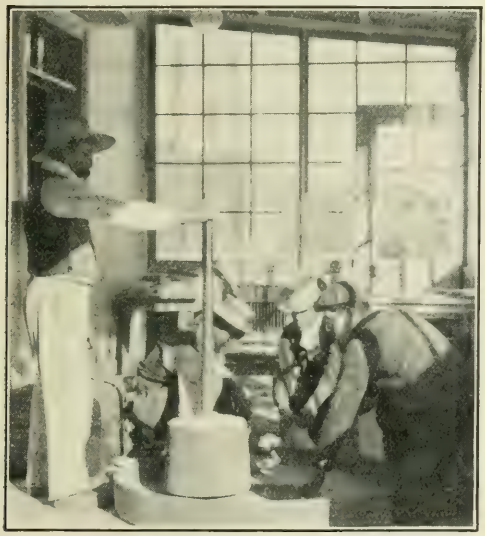
Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Sampling.

The Editor:

Sir—There seems to be little written in regard to the quantity of samples that can ordinarily be crushed per day, preparatory to 'bucking down,' in view of which the following data may be of interest. Perhaps they are peculiar to practice in Chile.

The samples were reduced to about ½ inch mesh and quartered to a weight of 2 kilo. previous to fine crushing as shown in the photograph. The circular plate, 4 ft. diam., is a casting with a rim 3 in. high, the outlet or 'discharge' being 6 inches wide. The 'muller' weighs from 100 to 125 lb. (as shown it is 15 in. diam. and 12 in. high), the heavier weight giving better results, and can be manipulated, with practice, without much force being required; a circular or gyratory motion is given to the handle, so that the 'muller' moves over the spread-out sample rapidly, and crushes without causing the pulp to fly off the plate. A practised hand can readily crush a sample, as mentioned above, so that 60% of it is finer than 20 mesh in 4 to 5 minutes. It should be stated that the material crushed was a copper-bearing (chiefly chrysocolla and malachite) andesite.



Reducing Samples.

With the four men shown—the two in the foreground doing the crushing alternately, the third clearing up the crushed sample into the sample-bag, while the fourth assisted in mixing the sample prior to it being quartered on the sampler—it was possible to crush, quarter, mark, sack in duplicate, and seal 150 samples (averaging about 150 gm. each) in 12 working hours—from 7 a.m. to 10 p.m.—allowing 3 hours for meals and rest.

The photograph shows the arrangement used to supervise the work while the quartering was being done. Incidentally it might be added that the labour cost (at 25 centavos per hour—or 5·6 cents U.S. currency) was 12 pesos (about $2·70) or 8 centavos (about 1·8 cents) per sample.

L. W. Strauss.

Chala, Chile, October 13.

Cyanidation v. Concentration.

The Editor:

Sir—Opinion is divided in Mexico on the subject of concentration as applied to ordinary milling ores, such as those of Pachuca. Discussion, however, generally proceeds upon metallurgical lines and the crux of the argument lies in the comparative efficiency of the method of direct cyanidation, as compared with a combination of concentration and cyanidation.

The object of this note is to point out that the comparative result reaches beyond the mere metallurgical efficiency and should be based upon the cost per ounce of silver produced, particularly because of the high refining charge on the silver bullion sold from the cyanide plant.

It is, of course, generally known that the silver bullion produced from a cyanide plant is more or less base, and must be refined before it can be marketed, but it is not generally known that the refining charges equal about 0·8d. per ounce of bullion which adds appreciably to the cost per ounce of fine silver produced. To take a case: An ore that yields 30 oz. fine silver per ton returns 33·30 oz. of 900 fine bullion. At a cost of 0·8d. per oz. of bullion the refining charge per ounce of fine silver produced comes to approximately 0·89d. The yield per ton in fine silver being 30 oz., the refining charge adds no less than 26·7d. per ton to the cost of production.

On normal Pachuca ores it is usual to get, in a concentrate representing half of one per cent. of the ore milled, about 20% of the total assay-value, that is, a ton of ore assaying 30 oz. per ton—assuming for this purpose complete extraction—will yield 10 lb. of concentrate assaying 1200 oz. per ton. The cost to

produce a ton of concentrate in Pachuca is just about £10 per ton, the freight and treatment charges are about 42s. per ton and the deduction for loss in silver treatment is 5%. Therefore the cost per ounce of silver produced from concentrate is as under:

Cost to produce 1 ton of concentrate	£10	0	0
Freight and treatment	2	2	0
Loss in treatment	6	0	0
	£18	2	0

Total silver produced from one ton of concentrate	1140 oz.
Cost to produce one ounce of silver	3·83d.

There are no refining charges made on concentrate, therefore the above figure represents the final cost.

The approximate total cost for producing an ounce of fine silver by cyanide treatment from a 20 oz. ore is as under:

	Per ton
Cost of cyaniding, precipitation, and melting	4s. 6d.
Refining cost	2s 3d.
Loss on treatment	5s. 6d.
	12s. 3d.

Total fine silver produced from one ton of ore	27 oz.
Cost per ounce of fine silver produced	5·44d.

No commissions are charged in either case on the bullion realizations, but these would favour the case for part concentration.

The example cited must be taken to refer of course only to Pachuca conditions. Every case must naturally be settled in accordance with the particular circumstances presented. Variations in grade of ore, in cost of cyanidation, in freight and smelter rates, and possibilities for concentrating valuable contents into small bulk, materially affect the question, so that no general rule applies all round.

Account must also be taken of the fact that from the smelter it is rare to get a satisfactory reconciliation, either on the dry weight of the concentrate, or on its assay-value.

G. A. DENNY.

London, November 15.

Standardization in Assays.

The Editor:

Sir—In these days the tendency is to standardize methods and materials, for reasons that are self-evident. In mining and metallurgy the powers that be have striven to standardize as far as possible. It would appear unnecessary to standardize in the method of reporting 'moisture' present in ores, etc.: that moisture could be reported otherwise than in percentage seems almost impossible, yet at least one large metallurgical works in Great Britain reports moisture in terms of drachms of water in one pound of material. Another equally large and influential firm reports moisture in a way that is equally puzzling to an engineer, thus: if a material contain 10% of moisture the report will read: "Moisture $\frac{700}{7000}$," meaning presumably 700 (grains) of moisture in 7000 (grains, or one lb. avoirdupois) of material. It is only reasonable to assume that both the above mentioned methods of reporting 'moisture' must in some respects be superior to the percentage method, which the writer had previously thought was almost, if not quite, universal, or else the methods must be a relic of a by-gone age. These two instances may perhaps be of assistance to some who, after working for years with modern methods in the back and beyond, are suddenly confronted with other ways of doing the same thing.

From the above it will be seen how necessary it is to standardize even the methods of reporting the amount of moisture present in ores, etc., and equally how little effect the attempt to introduce the metric system, even where most easily adopted, has in some quarters.

The successful standardization of weights used by gold and silver assayers would guard against errors frequently made, some of which involve enormous losses.

It is, in the colonies at least, usual for assayers on gold mines to use for weighing their parted gold a set of weights in which 1000 = 1 gramme and therefore the weight marked 1 = 1 milligramme; this appears good practice and serves as a direct link with the well known assay-ton weight. There is also a set of weights made in which 1000 = ½ gramme, and therefore the weight marked 1 = ½ milligramme. It may be urged that the weights of these two separate sets would even if 'mixed' be detected at once on sight; it may, or may not, be so, but the fact remains that serious errors have sometimes come about through mixing these two classes of weights, causing assay results to be reported at either double or half the truth. In a notorious case a few years ago the whole of the assays for one level of a developing mine were reported and mapped at double their true value, and when the error was discovered it proved serious for the assayer, and also someone else.

It must be remembered that assayers on gold mines usually work at high pressure, and unlike some of their city colleagues have to turn out results promptly if they are to be of any use to the management, and nothing but loss of time and risk of error can result

from using more than one system of weights on the same balance. With the extremely sensitive assay-balances now used on gold mines it is doubtful if any weight or rider weighing less that 1 milligramme can possibly be required.

A strange weight used is an assay-ton 'grain' weight; it is stated to be necessary for those who still report results only in grains per ton. When this assay-ton 'grain' weight was used in error instead of the standard short assay-ton weight for weighing the assay charge, and the parted gold was weighed in terms of milligrammes, the result can be imagined.

H. T. DURANT.

London, November 15.

A Miner's Protest.

The Editor:

Sir—In your current issue, 'Reef Miner' protests against the assertions (authorities not quoted) as to the inefficiency of Rand miners. In raising his protest, he wields the bludgeon of his angry resentment fiercely and blindly, and it is difficult to determine his final aim. In getting at his unspecified victim, however, your correspondent does so much miscellaneous damage on the way, that I will merely examine this subsidiary wreckage, leaving the poor battered culprit to appear from beneath and reply for himself.

Concerning the general proposition as to whether the Rand miner is 'inefficient' or otherwise, it seems to me just as futile to attempt to demonstrate the average efficiency of an essentially heterogeneous body of 15,000, as to prove their 'inefficiency.' The terms, implying our ability to estimate an average, are purely relative to their application, and there exists no outside standard for comparison. It is a matter of personal opinion, based largely on impressions that must vary with different experiences. There are many authorities who have good right to express their views, but debate of so indefinite a question affords no satisfactory means of proof, suggests no scheme for improvement, and creates much bitterness of feeling. A comparison of the Rand's average efficiency of today, and of, say, five years ago, might be attempted on a rational basis of detailed mining results. But even then, we would have no right to interpret better or worse average results as clear evidence of greater or less individual efficiency or output of work. There are too many variable factors, such as quality and working conditions that would still leave the question obscure.

'Reef Miner' writes in an angry mood, and seems anxious to aggravate bad feeling between masters and men, like some of the good people who fatten on that turbid sentiment. Pardon me, therefore, if I endeavour to carry the discussion to a lighter atmosphere. We read: "In other trades, the best market attracts the most skilled men. I believe we have the best miners from Europe, America, and the Colonies. It is the system for which the managers are responsible that is bad." It seems strange indeed that the "best market" should attract the "most skilled men" among miners but not among managers. Perhaps 'Reef Miner' places management under the head of white unskilled labour, for which the Rand is admittedly unattractive. He proceeds at great length to discuss the useful influence upon the Kaffir of the Rand miner who "converts the useless latent power of the native into a useful profitable asset. It is a psychological peculiarity of the native that his ideas of direction and motion are round. It may be environment." I don't think a lode or coal miner would agree with 'Reef Miner' here; not *verbatim*. He would be more likely to attribute the predilection to constitutional antipathy to pedal parabolæ. Continuing, he says: "His first idea was circular . . . . all his fortifications are circular, his utensils, his hut, threshing-floors, wicker cages, baskets, pottery, and cooking gear are round." Why on earth should this mental bias be recorded as proof of the Kaffir's latent uselessness in mining? Some of the best Rand miners of my acquaintance are feverishly anxious to see a good round figure on their monthly cheques and then to obtain the value of these rectangular slips, without delay, in circular form.

Although so unconvincing, 'Reef Miner' follows this washy line of argument still further. He even tells us how he "put in four pegs for a rectangular prospecting pit in Rhodesia and started a native accordingly." He "came back in three days. It was a circular shaft. The savage reverted to type. Therefore the native cannot be a miner." Truly a startling and illogical inference; and what poor appreciation of the trusty native miner, who only wished his absent manager to keep abreast of the times in shaft-sinking practice.

'Reef Miner' also wields two blows at the Transvaal mining regulations and deplores their excessive severity upon miners and the crushing penalties for their abuse. That these regulations are exceptionally elaborate in their injunctions on all classes of white employee (official and otherwise), owing to the peculiar

element of responsibility attaching to the control of raw natives, is to be readily admitted, but it must also be understood that they are applied with proper latitude, discriminating between the culpable carelessness of the old offender and the faults of the comparatively inexperienced, but well meaning, young miner. If the regulations were invariably acted upon by quibbling lawyers, instead of by men with a common-sense appreciation of mining difficulties, they might—like the Home regulations, passed and contemplated—become the curse 'Reef Miner' suggests.

Finally your correspondent strikes off tangentially from the Kaffir circles, and indicates that nowadays it is typical to drive the wrong way upon cutting a fault in Rand development. He adds: "Compare the drifts advanced in pre-war days, when the miner was paid and appreciated, with the modern manager's workings. Something needs blotting out: better it would be to totally blot out the present methods." This final sweep of the bludgeon is simply devastating. It indicates, too, a healthy spirit of constructive reform. The question is again one calling for more judgment than scientific proof. It is most probable that less wasteful exploratory development is undertaken nowadays, although backs are longer and individual drift-faces more isolated from other workings, for the simple reason that the constantly increasing accumulation of data generally renders the determination of a fault's identity and influence less and less difficult. How would 'Reef Miner' solve the problems of faulting, and improve "present methods?" Perhaps he would put in four pegs and tell his Rhodesian Kaffir to drive. Then return in three days, trusting that the native's psychological peculiarity in relation to the circular would lead him straightway to the desired round pebbles of banket.

I fear, however, that your Krugersdorp correspondent's ideas are at times too tangled for such interpretations. What encouragement can be derived from his 'Protest,' when he would have us believe that, since the war, the Rand miner has not been properly paid and appreciated, and that, nevertheless, the Rand has the best miners from Europe, America, and the Colonies, because it is the "best market." Here, at last, it would appear "that something needs blotting out," even though it be merely one of 'Reef Miner's' fundamental arguments.

RALPH STOKES.

Cornwall, November 24.

Casapalca Smelter.

The Editor:

Sir—In the July issue of your magazine my description of the Casapalca smelter reads incoherent. Absence in the interior has prevented prior correction.

The first three paragraphs contains statements different from those made in my manuscript; to those who know Casapalca they must appear inconsistent. In 1888 the smelter was treating silver-lead ores from mines owned by Backus & Johnston, as well as doing custom work. The scarcity of lead ores induced the owners to adopt copper smelting. The smelter and principal mines are situated at Casapalca, on the Central Railroad of Peru, 95 miles from Callao, the seaport. The Natividad mine is at Morococha and is not the chief mine of the Backus & Johnston Co.; they hold 50% interest in this property, the remaining half being held by the Morococha Mining Co., which ships its share of the ore to the smelter of the Cerro de Pasco Co. The ore is a mixture of enargite, pyrite, and chalcopyrite in an aluminous gangue containing little or no lead and zinc. The Carmen property—not owned by the Backus & Johnston Co.—is at Casapalca. On the first line of the third paragraph the unfortunate substitution of Natividad for Casapalca makes the description apply to conditions not existing.

The ton of 2000 pounds is used throughout the paper; the silver assays are given in ounces per ton of 2240 pounds.

LESTER W. STRAUSS.

Lima, November 1.

[Contributors are advised to send typewritten manuscript and to edit their articles carefully before transmission.—EDITOR.]

Estimates of Extraction.

The Editor:

Sir—Regarding the subject of East Rand troubles, touched upon in your valuable issues of September and October last, and setting aside any financial or speculative views involved, it seems that discrepancies between theoretical and practical extractions actually come as an aggravating factor in that complicated case.

It would be interesting to know how far differences between calculated recovery and hard cash produced at gold mines are expected to follow any settled rule, in the wide range from scientific to rule-of-thumb, before necessitating an explanation to shareholders. I believe, however, that 5% is a fair margin to contend with, provided that percentage were not, through systematic errors, always thrown

out on the same side of the truth. I should also like to point out two such possible errors, namely, in sampling ore in its various states of reduction and in weighing of assays.

Sampling, to be reliable, must often be done in different ways, checking one against another; especially on the Rand, where ore is uneven, as in any ore containing free gold. At a mine not far from Krugersdorp, we had once to make a rule to get two samples of the same tailing before cyanidation, duplicating the one already taken from every car on its way from the settling to the cyanide vats, by another taken with a rod from the charge in place just before treatment. Previous to that step, discrepancies were frequent, and upon investigation it was found that the boy in charge of the sampling, having both his hands occupied by taking a sample on one side and putting in a dose of lime on the other, would select the driest and cleanest spot in the car—also the richest in that particular case—and let pass any slimy car, without sampling it, so as not to have to shake off any wet stuff sticking to his scoop between takings. Entreaties, then threats, elicited from him a hearty promise to sample rightly, which he fulfilled only when he thought himself watched by a *baas*. Eventually that boy lost his job and had to be sent to one less responsible, before the extractions could be put under control again. Here, let us note how unsatisfactory often is the position of the assayer or of the analytical chemist at large, busy with fixing prices of goods. When his work goes all right, everybody thinks it is only natural, but when trouble arises he has none but hard and not always well-known natural facts to fall upon for an excuse. Among these, sampling is often done in the crudest way, and some gold mines would do well to imitate what is done by copper smelters in that line.

As to the weighing of assays and of assay-buttons after parting, it may be virtually called the weighing-out of the whole production of the gold mine, and that is done with only two kinds of weight. One is the various combinations of the assay-ton and subdivisions, used for assays before fusion. The other is the milligram-weights used for the parted gold buttons, being a wire rider and a wire or foil weight handled with pliers. The assay-ton weights as sold by the makers are fairly accurate; with proper use and ordinary care they vary but little, certainly less than ½% in years. But with the milligrams, errors can be found of several per cent, below or above, either when new or after some use. I have found up to 12% error on some new weights, and as to changes brought on by use it is better not to broach the subject. Comparing carefully a whole set of weights from the milligram up to the assay-ton is a delicate, long, tedious, and instructive work, leading sometimes to amazing results. There is mild foolishness in the combination of an extremely sensitive assay-balance and wrong small weights, for the elaborate clerical work based upon results therefrom is bound to be faulty. The only reasonable way out of such a difficulty is the one advocated by A. A. Hanks in the *Mining and Scientific Press* of May 13, 1911, to check the weights periodically, especially the smallest ones, against standard weights obtained from a Bureau of Standards. To minimize costs, one standard milligram and one standard assay-ton (or else half assay-ton) should suffice.

Reverting to the East Rand case, and supposing some errors imputable to weights to have occurred, it is true that different mines contribute; it is also possible that, with the overhauling incidental to the building up of the group, they all have been provided with new weights at the same time. While the ratios of gold in residues to gold in charges (sand or slime) or to gold in ore fed to stamps, as given by weighing respective buttons with the same small weights, remain unchanged, whatever may the ratio of such small weights be to the assay-ton weights, thus not affecting the theoretical extractions and giving no hint of trouble ahead, it is clear that any error in the ratio of incorrect weights should reflect itself upon the differences between real respective weights of assay-buttons of residues and charges, corresponding to cyanide bullion, and of charges and ore entering the mill, corresponding to amalgam.

J. F. COUTTET.

Budelière Chambon, France,
November 20.

Ball-Mill Practice.

The Editor:

Sir—In the concluding paragraph of my letter appearing in your October issue there is a mistake in the number of men. The number ought to be 8, not 28.

DONALD F. FOSTER.

Parral, Mexico,
November 4.

[Letters on 'Re-precipitation,' 'Single Shift on the Rand,' and the 'Origin of Petroleum,' are held over for our January issue].

PERSONAL

JOHN H. ALLEN, of New York, has been at the San Francisco del Oro Mine, Parral, Mexico.

PHILIP ARGALL sailed for New York on December 9.

H. A. BARKER sails on December 18 for Veracruz, on his return to Pachuca, Mexico.

J. M. BELL has returned from Russia.

FRANCIS P. BRAY sailed from Liverpool for the Gold Coast on December 13.

C. FORBES BROWN left London on December 6 for Northern Nigeria.

R. GILMAN BROWN has returned from one of his periodical visits to Kyshtim, Siberia.

E. R. BUCKLEY has opened an office at Chicago.

F. T. BYRDE has accepted an appointment with the Gold Coast Estates, in West Africa.

J. E. CLENNELL is with the Creston Colorada company at Torres, in Mexico.

B. I. COLLINGS has opened an office at Salisbury, Rhodesia.

G. A. DENNY sailed for Veracruz, Mexico, on December 9.

H. S. DENNY sailed for Mexico on November 29.

JAMES DOUGLAS sailed for New York on December 9.

W. R. FELDTMANN and JAMES A. MACTEAR are back from the Ashanti goldfield.

J. R. FINLAY has become consulting engineer with Charles Head & Co., New York.

ERNEST K. HALL, lately manager of the Progress and Wealth of Nations mines in New Zealand, has commenced practice at Sydney as consulting mining engineer and geologist.

W. T. HALLIMOND sailed by the *Saxon* for South Africa.

F. O. HARVEY has returned from Spain.

J. D. HENRY left London on December 9 for New York on his way to New Zealand.

C. S. HERZIG will arrive in London from Brazil on December 20.

AUGUST HOFFMANN, of the Sissert estate, is at Stockholm.

THEODORE J. HOOVER sailed for Australia on November 18.

J. C. INGLIS sails by the *Miltiades* on December 21 for Melbourne.

CARADOC JAMES has returned from the Gold Coast.

W. B. JEFFREY has returned to Oaxaca, Mexico.

CHARLES H. JONES has returned from Broken Hill.

J. E. JONES has left for Madagascar to investigate a nickel mine.

A. TREVELYAN KING is in Cornwall.

WILLIAM M. KNOX has returned from Eastern Siberia.

W. J. LORING is on his way to Burma.

V. F. STANLEY LOW has resigned as manager of the Broken Hill Block 10 mine.

E. C. MACKAY-HERIOT has left London for Central America.

L. S. MAYREIS has returned from America.

E. D. MCDERMOTT has gone to Nicaragua.

ANDREW MCWILLIAM has been appointed to the newly-formed post of metallurgical and analytical inspector of steel for the Indian Government.

AMBROSE MONELL was at Porcupine recently.

JOHN MORGAN, of the South Kalgurli, is here from Kalgoorlie.

C. H. MUNRO is expected in London from Eastern Siberia at the end of December.

F. DOUGLAS OSBORNE has returned to England after a visit to the tinfields of Swaziland and the Northern Transvaal.

W. PELLEW-HARVEY has been elected a director of the Great Cobar company.

C. W. PURINGTON has opened a branch office at 42 Moika, St. Petersburg.

L. D. RICKETTS is here, as adviser to the Arizona Copper Co., of Edinburgh.

H. M. RIDGE is recovering from an attack of diphtheria.

H. P. ROBERTSON sailed for Brazil on December 16.

R. H. RUNDLE has left London to become assayer to the Zaaiplaats Tin Mining Co., in the Transvaal.

F. C. SMITH has returned from the Gold Coast of West Africa.

R. E. SMITH, of Vladivostok, is at St. Petersburg.

O. J. STEINHART was in Sweden recently.

H. L. SULMAN distributed the prizes gained by students in the Sir John Cass Technical Institute on November 29.

W. R. THOMAS has left England for New South Wales.

C. F. TROUSDELL has returned from the Gold Coast.

H. W. TURNER has returned from Siberia.

MORTON WEBBER has arrived from New York on a visit to London.

HORACE V. WINCHELL has been examining mines in California.

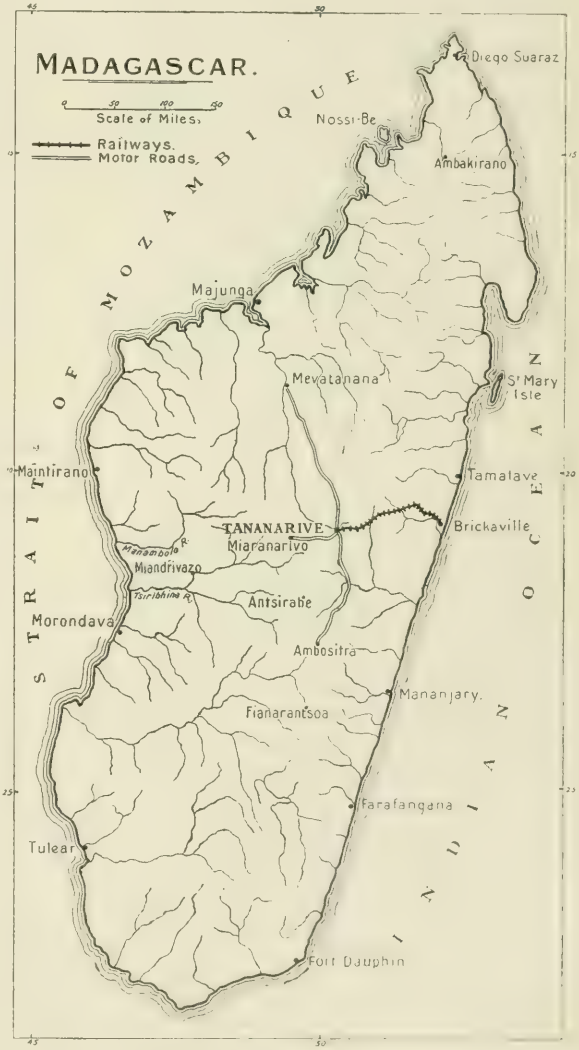
LOUIS A. WRIGHT is here on his way from China to New York.

MINING IN MADAGASCAR

By T. DRAPER.

MADAGASCAR is known to be highly mineralized and is generally regarded as being possessed of great resources. Its mineral wealth is varied and affords opportunities for exploiting either base or precious metals as well as a variety of precious stones. Previous to the conquest of the island by the French in 1895 mining was carried on principally by the natives, though a few Europeans succeeded in securing prospecting privileges of a precarious nature. Security of title was dependent on the goodwill of the ruler, whose courtiers were ever ready to turn to their own benefit any discovery of merit, and whose avarice and retrogressive spirit did much toward discouraging the influx of foreign prospectors. Even missionaries, to whose zeal the island owes much, were tolerated rather than encouraged and at times passed through periods of stress when life and property hung in the balance.

Previous to the year 1868 the government of the country was of a chaotic nature, periods of quietness and disorder alternating according to the disposition of the autocratic ruling spirit. From 1828 to 1861, during the reign of terror of Queen Ranavalona I, the country was practically closed to Europeans, and persecutions, directed more particularly against converts to Christianity and those who manifested a progressive spirit, were of daily occurrence. Executions were carried out by casting the condemned over the precipice on which the Royal Palace at Tananarive is situated. At least one European and several native missionaries are said to have suffered this fate, though it is not recorded whether they underwent the ordeal of *tangena*, a poisonous nut which acts as an emetic and which the accused was made to take in the form of a broth after having previously swallowed three pieces of the skin of a fowl: if he vomited the bits of skin he was considered innocent, otherwise he was condemned and executed. Whole villages were subjected to this barbarous trial. Ranavalona was succeeded by her son Radama II, who evinced a more placable spirit, but was of a weak disposition easily swayed by his favourites, foreign and native. From him an enterprising French company obtained extensive territorial privileges, which eventually led to his assassination by his own subjects and to the bombardment and occupation by the French of Majunga and Tamatave in 1883 during the reign of Ranavalona II, her predecessor, Queen Rasoherina, having previously repudiated the concession.



Within the last year a quiet revival of in-

terest in Madagascar has been taking place and there is an undercurrent of feeling that points to important developments in the near future. A description of the leading features and local conditions should therefore prove of interest.

With the exception of the coastal regions, which are low-lying, the island consists of an extended inland plateau with an elevation of some 5000 ft. above sea-level. The climate of the interior is healthy, the scenery picturesque and reminiscent of the high veld in South Africa. The rainfall is moderate, about 42 inches per annum, and occurs during the summer months, from September to May. During this period the coastal regions are unhealthy, fever and dysentery being prevalent, but not of a dangerous type. With moderate care Europeans experience no difficulty in keeping healthy, especially if periodical recuperative trips are made to the highlands. Blackwater fever occasionally manifests itself but seldom proves fatal. From enquiries made on the spot, principally from Europeans whose long residence enables their judgment to be accepted without reserve, it would appear that the unpleasant reputation of Madagascar is ill-deserved and is based principally on the high mortality experienced by the French troops during the conquest, when the sanitary arrangements left much to be desired and exposure was unavoidable. Since then the French have laboured incessantly to improve conditions and are to be congratulated on the successful issue in regard to the principal ports, Majunga, Diego Suarez, and Tamatave, which are now freed from the dreadful malarial scourges of the past. Successful war is being waged against the mosquito though the prevalence of water and stagnant pools renders progress slow. Madagascar, like the Klondike, is noted for the size and myriads of its mosquitos and a night passed at Brickaville on the way to Tananarive is an experience that will be remembered even by the most case-hardened.

The coastal regions, however, are with few exceptions not those in which minerals occur, and the few days spent in transit to the interior are not formidable. Tananarive is the best point of departure, being only a 24 hours' journey from Tamatave. Once on the highlands all goes well. An excellent service of motor-cars, running over roads that reflect infinite credit on the administration of the island, renders Miaranarivo, Antsirabe, Ambositra and Mevatanana, accessible with comfort and celerity. From these places any part of the mineralized portion of the island can be reached at the rate of about 25 miles per day by means of native bearers. In its early days Madagascar was dependent entirely upon its waterways and native carriers for its transport, and although the French have accomplished wonders by way of opening up the island, nevertheless, except in regard to the main roads, the early methods are still in vogue. These are slow and cumbersome to a degree, and withal expensive, but there is no satisfactory alternative. For a journey extending over a period of, say, two months, thirty or forty bearers or *boujanes* will be required, of whom from eight to ten will be used in relays to bear the palanquin, locally termed a *filanzane*, and the others to carry the camping outfit and provisions. The camping outfit should consist of a folding bed (with the indispensable mosquito curtain), a folding table and chairs, several blankets, sheets, and spare clothing, a good mackintosh, and a waterproof sheet. Tinned goods according to taste are advisable, though provisions in the form of fowls, eggs, potatoes, etc., are obtainable at prices that would, if more generally known, cause a stampede of all good housewives to Madagascar, to wit: eggs 3d. per dozen, fowls 6d. each, turkeys 1s., beef 2d. per lb., rice ½d. per lb. Wine is cheap and preferable to water, which is seldom above suspicion. A shot-gun for quail, partridges, and guinea-fowl will serve to provide a change of diet. A rifle is of no use except for crocodiles and for wild cattle on the west coast of the island. Packages are done up so as to weigh from 50 to 70 lb. and are carried on a pole slung between two bearers. A tin trunk for clothing and another as a grub-box are preferable to wooden ones in the rainy season. A white umbrella lined with green and a pair of smoked glasses will afford relief from the burning rays of the sun and from the glare, which at times is unbearable. A tent is a matter of personal taste. Villages are frequent and shelter of a kind can always be obtained, though the surroundings are not always of an inviting character. During the dry season villages are best avoided, as an unusual number of pigs and dogs are apt to render night hideous. This outfit, with its huge retinue of bearers, appears formidable enough, as indeed it is as far as expense is concerned, but the only alternative is to walk and court disaster. It is advisable when a long trip is contemplated to put oneself in the hands of an old resident accustomed to the conditions and if possible to secure one of these as a guide and companion.

Crushing selected Ore.

A Bateadora.

A Family of Bateadoras at work.

Illustrating Native Methods of Mining.

Geologically, Madagascar presents many features of interest. Only a small portion of its geology has been correlated up to the present, principally by missionaries, among whom Barron, of the London Missionary Society, figures most prominently. Gautier, the French geologist, has also written extensively on the subject, but there still remains a large and interesting field for study to any one desirous of achieving an honourable fame.

With the exception of a comparatively narrow strip of sedimentary deposits, representing about one-third of the total superficial area of the island extending along the western coast, the greater part of Madagascar consists of metamorphic and associated non-schistose rocks typically representative of the Archæan, or, in this instance, pre-Carboniferous period. Regional metamorphism has, in fact, prevailed over vast and monotonous areas broken only at rare intervals by granite of an intrusive type, as distinct from the associated granites exhibiting gradual transition into and affiliation with the gneissic masses. Volcanic intrusions of recent origin are also in evidence within the metamorphosed area and occur in the sedimentary area on the west coast, where several volcanic pipes and numerous diorite and basalt dikes have been observed. A noteworthy feature is the rarity of white or muscovite mica in the granites of Madagascar and the consequent scarcity of normal granite. The same characteristic feature, absence of white mica, is also observable in the gneisses, which, in addition, present the peculiarity of being almost invariably hornblendic. Felspar is an abundant constituent of the gneisses; the variety microcline, generally regarded as rare in biotite and hornblendic gneiss, is not uncommon in Madagascar. With these exceptions, the Archæan rocks of the island call for no special comment.

Turning to the sedimentary formations, which, as previously stated, are, except for a few isolated superficial deposits, confined to the west coast, these are found overlying the metamorphic series unconformably, dipping gently to the west, whereas the schists are titled at angles varying from 45 to 90 degrees. Owing to the rarity of fossils as well as to the limited number of geologists who have taken an interest in Madagascar, it is not possible to relegate the sedimentary formations to their proper geological horizons with any certainty. In the southern portion of the island a carboniferous formation has recently been identified, while in the middle west and northwest the Jurassic system has been positively recognized, but Triassic rocks are uncertain, while the Permian exists by inference only. Several noted geologists have recently visited Madagascar and their researches will undoubtedly do much toward clearing points at present obscure.

The prevalence of metamorphic rocks in Madagascar infers that the island should be rich in minerals, and although its mineral resources are not fully explored this inference is confirmed by the discoveries made up to date. Gold, copper, iron, lead, zinc, nickel, graphite, mica, uranium, asbestos, and precious stones are known to occur in quantities that should, and in many instances do, permit of profitable exploitation. Not all of these minerals are of economic value at the present time but their existence argues well for the future of the island. Coal measures have recently been identified in the south and indications of petroleum are numerous in the Sakalava valley.

Taking the minerals in the order of their importance, gold, by its wide dissemination throughout the metamorphic region, promises to develop into an important asset. A glance at the official map showing the mineral distribution of the island will confirm this impression. Fully one-half is labelled auriferous. The yellow splash of colour indexed as "*gisements d'or*" is truly remarkable in extent. Throughout the area indicated gold is at the present time being mined by crude but nonethe-less successful methods. The ubiquitous *batea*, a relic of the Portuguese occupation, operated by the unskilled hands of a *bateadora* adds its little quota of gold to an ever-increasing total. In 1897 the output was 2543 ounces, and at the present time it exceeds 80,000 oz. per annum, nine-tenths of which owes its recovery to laborious panning, unskilled sluicing, or 'gophering.' In the latter instance the selected ore is crushed in wooden mortars by pestles shod with iron. The accompanying photograph affords a good illustration. The methods are ludicrous but the result is significant. Up to date there are only two stamp-mills on the island neither of which has justified its installation, the larger, consisting of 25 stamps because of unskilled erection, the smaller because of antiquity sublime and hoary. It is estimated that half of the annual output is derived from sluicing of alluvial terraces and the remainder by *bateas* from streams and quartz veins. The quartz veins occur in the schists and gneiss and are generally well defined bodies that would repay exploitation by modern methods. Rich leaders are frequent and are

trenched and 'fossicked' by the natives for many hundreds of yards down to a depth of fifteen or twenty feet. No systematic work is being done except where several Europeans, hampered by lack of capital, are waging unsuccessful war against adverse conditions. The deepest shaft is said to be 120 feet. The gold mining industry is maintained almost entirely by the natives, who are invited by the owners of mining claims to exploit their ground. The owners, generally European, make no attempt to institute systematic development and are content to purchase the gold from the natives and re-sell at a profit. I know of several who are earning from £500 to £1000 per annum by this method. Naturally, mining carried on under these conditions does not tend either to permanency or progress. The haphazard methods of the Malagasy are, under these conditions, confined to surface scratching and are continued only as long as the maximum result can be obtained by a minimum effort. When results are no longer remunerative the natives shift to some other part, *en masse*, and leave the concessionaire to reflect mournfully on the wealth untold, and unattainable, under his feet. Lack of capital to him means lack of method, so he too shifts ground and starts again under the same conditions. Unsatisfactory to a degree, this method has yet shown Madagascar to be highly auriferous, and a large proportion of its inhabitants are engaged in shifting their ground from year to year. Unfortunately for the country it has had several gold booms, engineered by unscrupulous adventurers, that have brought it into evil repute. To make matters worse, the Malagasy are not unskilled in the art of 'salting' and several scandals are now being lived down. Professional brethren who may have occasion to visit the island in the future are advised to exercise more than ordinary care, especially when dealing with alluvial ground.

The rivers of Madagascar, especially those on the west coast, are highly auriferous and suitable for dredging. The base metals call for no special comment. Copper, iron, and lead are plentiful, though silver is rare. Zinc and nickel are known in quantity but have not yet been exploited on a large scale. Graphite of good quality is being exported. Uranium has recently been discovered and is being mined at Antsirabe. Tin and cobalt ores have been found in several localities. The precious stones of Madagascar comprise tourmaline, garnet, and various others of lesser value, but beryl, ruby, and sapphire, some of which command high prices, are also found. The Madagascar aquamarine is in demand, and recently another variety of beryl found here, to be called morganite, was described in the *American Journal of Science*. Diamonds have been reported and, as peridotite is known to occur, the discovery of a diamond mine is not improbable. Intelligent prospecting is what the island needs. Apart from the military, the European community is small and is engaged solely in commercial pursuits. Prospecting is done only by casual visitors who have in too many cases ultimately victimized their friends on the other side of the Mozambique Channel.

Mining in the strict sense of the term, whether for gold, base metals, or for precious stones, is as yet unknown in Madagascar, but it may safely be predicted that the near future will witness a complete change. It is within the bounds of probability that the discovery of petroleum will give the needed impetus to the island. Systematic boring for oil is being conducted in the Sakalava valley on the western side of the island, where the geological features are such as may lead to the discovery of an oilfield at any moment. It is reported that small quantities of oil have already been found in a well seven or eight miles southwest of the village of Folakara. The definition of the oil belt seems to be only a question of time and money. Large areas are held for exploitation of petroleum and greater activity is predicted. The import duties on oil into France will give Madagascar an advantage over the European and other oilfields, while its proximity to South Africa will be in its favour.

The mining laws of Madagascar are liberal in the extreme, and every encouragement is given to legitimate mining enterprises. An unsatisfactory feature is that labour threatens to be both scarce and unskilled. The native population is agricultural and pastoral and mining has not yet attracted the attention of the labourer.

Australian Iron Resources have received the close attention of the New South Wales Government, and F. W. Paul, an English authority on iron and steel, has recently been commissioned to examine the situation and give his views. His report has just been issued and is entirely favourable to the establishment of an iron and steel industry depending solely on Australian ores and coal. He considers that hematite pig iron could be produced at a cost of 54s. per ton, steel rails at £6. 10s., and galvanized iron sheets at £16; the corresponding selling prices at works in England are £3, £6, and £12.

THE FINANCE OF A MINE. VI.

By M. H. BURNHAM.

IN the preceding articles I have attempted to set out the principles governing the economics of mining finance, but as several months have elapsed between the first and the present article, it may be well to recapitulate the views expressed.

Premise No. 1.—The basic premise is that the engineer may not escape the necessity of dealing with the economics of finance, resting this contention upon:

(*a*) The fact that flotations of any magnitude place the engineer's name prominently in prospectuses, thus by inference making him sponsor not only for the cash outlay, but for the price per share paid by subscribers.

(*b*) The necessity for the engineer acting as negotiator in foreign parts where payment may, and generally should, be made in shares or debentures.

(*c*) The growing practice of placing engineers on company boards.

Premise No. 2.—The second premise advanced is the ordinary business concept that all sound calculations essentially entail the assumption of capital return, a rate equal to Consols, and a further rate as an allowance for risk, counting from the date of investment.

The development of the second premise led to:

Development No. 1.—Allowance for risk is based on the amount of relevant data obtainable, varying inversely. From a consideration of data bearing on valuation, it was thought possible to separate it, placing it under two heads:

(*a*) Data based on geological surmise only, that is, wanting sampling verification. This may be called 'possible ore.'

(*b*) Data from sampling the whole or a portion of the periphery of a block of ore. This may be called 'probable' ore.

As will be seen, both are cases of assumption, the former having to assume both occurrence and continuity, while the latter (*b*) has only to assume continuity from the sampled surface to the centre of the block.

From the extra uncertainty attaching to (*a*), it was found that

(*c*) Sound practice permitted expenditure on exploration alone, where the basis of valuation was merely geological surmise.

A further development of Premise No. 2 lead to the view that as

(*d*) The risk-rate in ordinary business enterprises varies inversely with the data available, therefore a block of ore in a mine should be so valued. Hence:

(*e*) Within the limits set by the dimensions of the standard block the risk-rate applicable to each block should vary inversely with the number of full-section samples available.

A study of the occurrence of the rich and poor parts of a block as shown by a carefully prepared assay-plan indicate that:

Development No. 2.—Depending upon the homogeneity of the shoot, a ratio of sampled periphery to cubic contents exists for each, to exceed which entails a greater risk; that is, a standard block must be determined having dimensions dependent upon the homogeneity of the shoot.

(*a*) The risk-rate for the standard block will be the minimum for the undertaking.

This, in general, means the risks exterior to the mine itself, such as war, pestilence, famine, strikes, losses in marketing the metal, hence varying with the nature of the product and geographical position.

As the risk varies inversely with the number of sample-sections available, it follows that:

(*b*) Blocks sampled on three, two, or one side may be given a definite value on the basis of a risk-rate varying as the ratio of the number of sample-sections taken to those available if the block were divided into two or more blocks, each of standard dimensions.

In those cases where the capital is fixed, with the profit per ton and dimensions of the shoot known, the dividends to come from one year's exhaustion of the shoots are also known; hence, as the lowest level in the typical mine may be considered to be the upper side of a

block of ore of unknown vertical dimension, the risk-rate must vary with the depth. In other words, the ratio of the data available from sampling the lower level, to the data necessary to insure a minimum risk-rate, becomes less and less as the vertical dimension of the block increases.

We thus come to the position that:

Development No. 3.—Shoot extension must be allowed for, but that this allowance will depend upon the dividends available from the ground.

As has been set out, this allowance incorporates not only the length and thickness of the ore-shoot, but takes into consideration the number of levels available above the lowest, as well as the profit per ton. Otherwise, the allowable shoot-extension is a function of the economic dimensions of the ore-shoot, not the physical dimensions alone. The above, of course, is applicable only in the event of there being no adverse geological data.

It follows from No. 3 that

(*a*) Ore lying below that point determined as the lower limit of allowable shoot-extension and which may be paid for, is no longer 'probable' but becomes 'possible' only and outlay other than for exploration is unsound.

The above conclusion places this 'possible' ore in much the same category as the 'possible' ore of an outcrop (see plan of Fig. 5) which promises ore below, but shows no sample-values; in other words, the data may warrant outlay, but only on exploration and not for purchase.

Evidently, while there may be no essential difference between outlay on purchase and on exploration, the latter is the minimum expenditure, in keeping with the fact that where

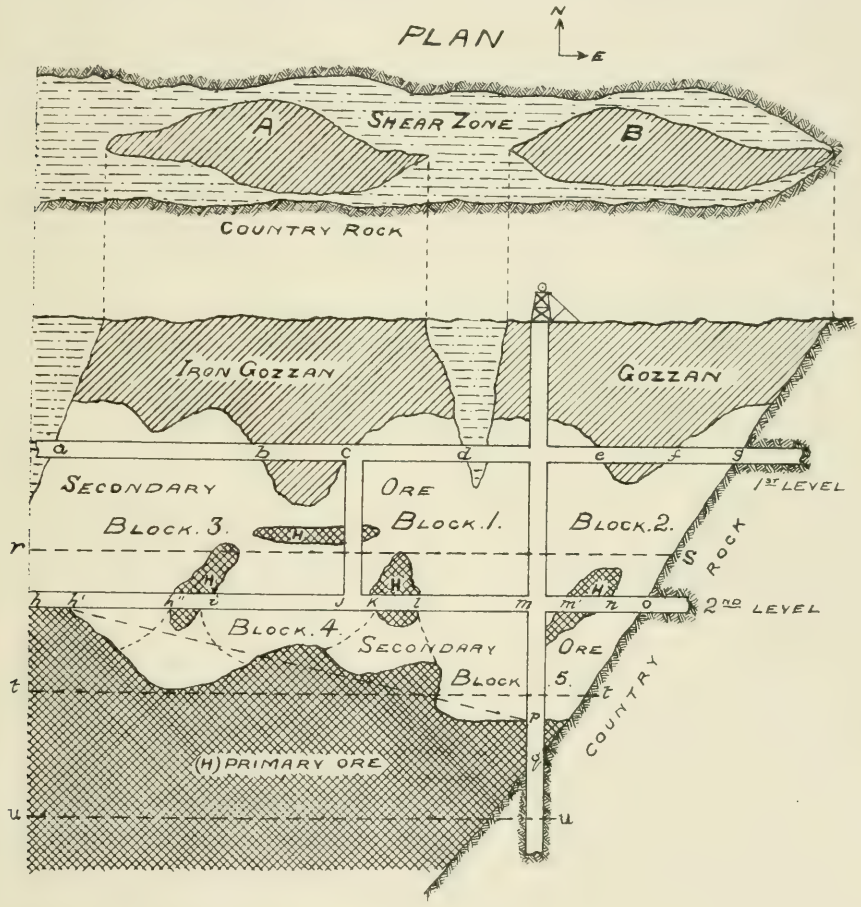


Fig. 5. PLAN AND SECTION OF A TYPICAL COPPER MINE.

outlay is based on geographical surmise only, the data also are a minimum.

Development No. 4.—Any outlay, for exploration or otherwise, presupposes the existence of orebodies of sufficient economic magnitude to repay the capital and interest stipulated.

It follows from No. 4 that whenever an engineer or geologist advises outlay on exploration, he commits himself to the tacit assumption of enough profitable ore to repay that expended upon exploration, development, plant, capital return, and interest.

From this it becomes necessary to consider current practice with regard to expenditure on shoot-extension alone, outlay on this having a bearing on exploration expenditure, and Table IV. (see issue of August) was prepared for this purpose.

gage becoming operative on non-payment of interest together with arrears.

Fig. 5 will serve to illustrate a typical copper mine. As will be seen on the plan, the areas A and B represent the gossan or portion of the outcrop originally occupied either by pyritic material or altered by subsequent sulphate solutions; in any event, the magnitude of the combined areas of A and B is the first factor of economic importance, unless, of course, they carry profitable ore.

Evidently, if A and B be but a few square feet in area little attention would ordinarily be paid to them; if, on the other hand, they prove to be of great extent and the district promising, both geologically and economically, one might feel justified in advising outlay for exploration. A careful man, however, would not advise a payment to vendors; yet, on the

TABLE VIII.

Block	Net tons	Years of Life	Years of Deferment	Net Profit £	Number of sample-sections	Risk-Rate %	Factor from Table VI	Present Value £
1	50000	1	2	50000	100	5	0·79383	40000
2	60000	1	3	80000	75	7	0·68301	55000
2A	10000	1	4	5000	25	20	0·35520	2000
3	40000		4	40000	80	6	0·64993	26000
3A	60000	1	5	90000	50	10	0·48032	43000
4	70000	1	7	50000	75	7	0·46651	23000
5	20000		6	10000	50	10	0·42506	4000
Total...	—	—	—	325000	—	—	—	193000

Before comparison could be made, it was imperative to evolve a unit applicable to each: this was called the 'shoot-foot,' being based on the concept of the economic shoot, which is:

(*a*) The number of sovereigns of profit obtained by exhausting the ore-shoots at the lowest known point to a depth of one foot.

The development of Premise No. 2 also leads to:

Development No. 5.—When dividends are delayed (or deferred) for a period, those received later must make good the loss of interest due to such delay. In other words, when valuing blocks of ore, the exhaustion of which is delayed beyond one year from date of outlay, sound calculation demanded that this loss of interest must be considered. In financial practice this principle is recognized by the issue of cumulative shares and by the foreclosure clause of debenture mort-

other hand, so long as expenditure is advised, it matters little to those finding the capital to whom or for what purpose it be expended.

The real point is the tacit admission that the minimum of data, that is, geological surmise unsupported by profitable ore, calls for the minimum of outlay, which of necessity is that on exploration only. But even this outlay implies that the capital expended on exploration will be redeemed as well as interest paid. In other words, the minimum economic dimensions of the postulated orebodies is shown by the magnitude of the outlay advised by the engineer.

As set out before, a convenient unit is the profit obtained (with a plant of given capacity) from exhausting such an orebody or ore-shoot to a depth of one foot. On this basis an economic comparison of mines can be made independent of their reserves or of their physical magnitude.

If the gossan on the surface shown in Fig.

5 carried no profitable ore, expenditure for whatever purpose would entail the assumption of finding profitable ore in payable quantity, on, say, the line $r-s$. And though the only gauge of the magnitude of a slice along $r-s$ is the area of A and B, it is essential to a clear exposition of the promise of the venture that the economic magnitude of this slice be set out; column 6 of Table IV is interesting as showing the approximate magnitude of such a slice through a number of well known mines. The table also shows how distinct the economic slice is from the physical slice.

Evidently the capital outlay, either on exploration alone, or as expressed in the capital of the company, divided by the economic magnitude of the shoot, gives the assumed shoot-extension necessary to repay the capital alone, provided there be no reserves.

Turning to Block 1 of Fig. 5, it will be seen that a careful sampling of the drifts and winzes will show three patches of lower-grade ore, each of unknown extension into the body of the block. As, however, they appear to be small with reference to the size of the block, that is, they do not pass through it either way, the risk-rate for this block may be taken as the lowest allowable for the mines, let us say 5 per cent.

Block 2, however, not having a winze to the east, may have a bulge in the country-rock; hence, in default of this winze only $\frac{3}{4}$ of the data are available, and the risk-rate may be taken at $5 \times \frac{4}{3}$ or say 7 per cent.

Block 3 will be seen to be short of the two winzes thought necessary to prove the size of the lean patches, hence, assuming a standard square block and an equal weighting for the sampling data obtained from winzes and levels, the eastern section should be given a risk-rate of 7%, like Block 2, while the western part would require one of 10 per cent.

The weighting of Blocks 4 and 5 will, of course, be largely governed by the geological evidence, for, as will be seen, the low-grade primary ore sampled at $h''-i$ and $k-l$ may be as shown, or they may be parts of the main body as indicated by the dotted line. Under such circumstances some would no doubt draw the line $h''-p$ and consider this the block, allowing it a risk-rate of say 10%. In these cases, however, geological data may indicate

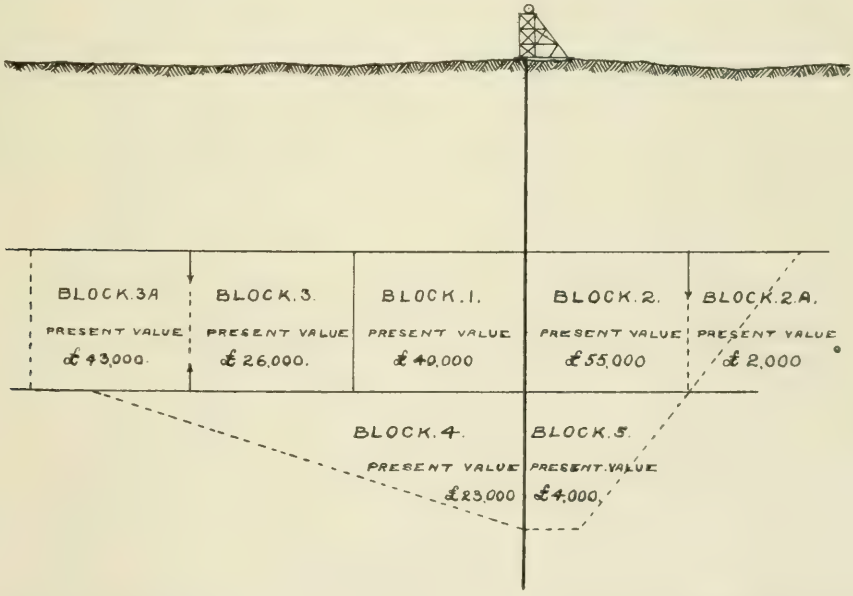


Fig. 6. DIAGRAMMATIC SKETCH OF MINE. Solid lines = work done; dotted lines = estimated boundaries of blocks.

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As will be seen, the blocks will usually be exhausted at a different time, hence a different deferment factor must be allowed for each, as indicated by Table VIII.

The practical import of the foregoing and essential contention is that every company should publish, not only at flotation, but periodically, a small sketch (Fig. 6), something like

Fig. 5, setting out the estimated present value of each block. Evidently the value will vary from time to time, not only for the blocks in the process of development, but for those fully developed. It may be asked, however, if this variation in value is not also true of any of the assets of ordinary commercial undertakings, from bankers' securities to the stock of a greengrocer.

THE BLACKWATER MINE

By HAROLD SHARPLEY.

THE Blackwater gold mine is situated on the west coast of the South Island of New Zealand, and is reached by a train and coach journey of 43 miles from Greymouth. The ore is a banded quartz carrying coarse gold, and is extracted through two adits. The ore is discharged from the mill-bin on to grizzlies set 1½ in. apart, the oversize being fed by a shaking feeder into a 10 by 12 in. Blake-Marsden crusher capable of crushing 6 tons per hour to 1½ in. From the crusher the broken ore falls into the main storage bin. The undersize from the grizzlies gravitates direct to the storage bin. From tests taken it was found that approximately 10% of this undersize would pass an 18-mesh screen (0·037 in. aperture) and it is hoped at some later date to pass this over a revolving screen (with 0·037 in. aperture) and by-pass the undersize direct to the amalgamating tables.

The ore is fed direct from the storage bin to the 30 stamps by Nelson suspended feeders. The stamps weigh 950 lb. when new, and are run at 98 to 100 drops of 7½ to 8 in. per minute. The shoes and dies are 9 in. in diameter. The mortar boxes are fitted with 4½-mesh (0·166 in. aperture) and 18-mesh (0·037 in. aperture) double crimped steel screens, sufficient 4½-mesh screens being used to keep the 16 by 4 ft. tube-mill supplied with + 0·037 in. material for grinding. The pulp from any boxes that may be fitted with 18-mesh screens flows direct to the distributing box above the plates, while the pulp from the 4½-mesh screens gravitates into the boot of a 12-in. bucket elevator which elevates the pulp 16 ft. into a hopper. From here it passes over a launder with a false bottom 5 ft. long composed of 18-mesh brass screening. A considerable quantity of the fine stuff falls through this screen, and passes direct to the distributing box over the amalgamating tables. The remainder of the pulp passes into the feed pot of a 36-in. 'B.M.' revolving screen covered with 18-mesh brass screen cloth. The undersize passes direct into the distributing box above the amalgamating tables while the oversize falls on to a 36-in. 'Bunker Hill' screen travelling at 20 rev. per min. The undersize from this screen goes direct to the distributing box above the amalgamating tables while the oversize forms the feed for the tube-mill. This tube-mill is fitted with Brown liners, and flints are used. The ground pulp is lifted by a Frenier pump to a distributing box. The pulp is distributed by goose-necked pipes to launders which convey it to 9 amalgamating tables, with a plate area of 490 sq. ft. From these plates the pulp travels to 8 small cone thickeners, the thickened pulp being fed on to four No. 5 Wilfley tables. The concentrate falls into a launder and flows over two small amalgamating plates to catch any free gold, and thence to storage bins.

We intend ultimately to close the pulp circuit by adding a 10-in. bucket elevator at the discharge end of the tube-mill and elevating the pulp to a height of 32 ft. over another 'B.M.' revolving screen to be placed immediately over the present screen; in this way any + 0·037 in. particles discharged from the tube-mill would find their way back again.

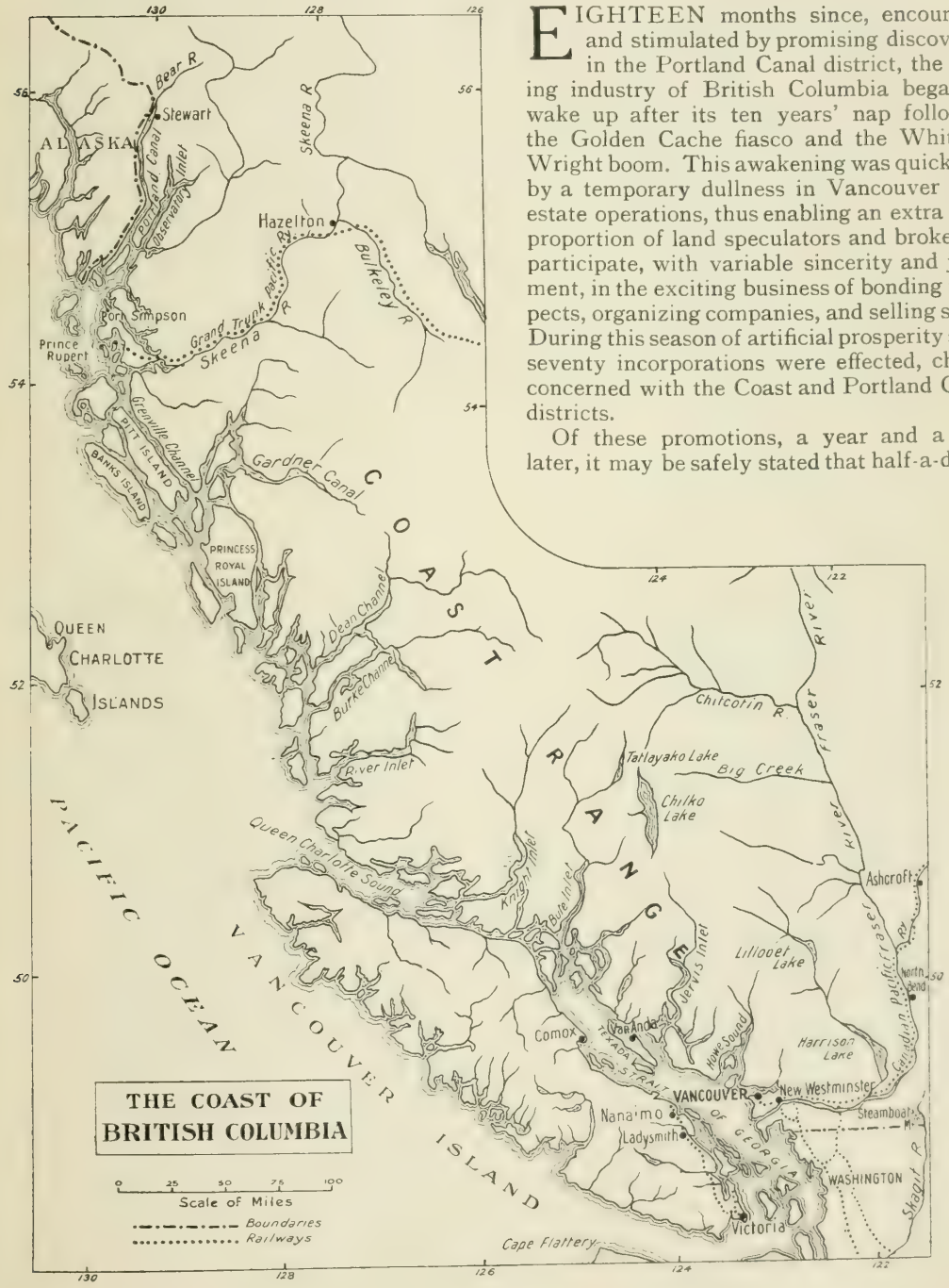
At present the tailing from the Wilfley tables flows to two 4 ft. conical steel settlers, and four wooden classifiers. The conical steel settlers are 4 ft. deep with an annular overflow, and are fitted with a diaphragm. The overflow goes to the slime dam and the underflow to the cyanide plant. As the cyanide plant is now too small to treat the quantity of sand produced it is now being increased, and we propose to substitute four 8-ft. Callow thickeners for the present steel and wooden classifiers. These will then be placed in a central position above the cyanide plant, the pulp being discharged by goose-necks to a travelling distributor running on a track laid across the tops of the vats.

The motive power for this plant is provided by two 6-ft. Pelton wheels with 6 and 9-in. buckets, and a suction gas engine, the latter acting as an auxiliary when the water is low. The water for the Pelton wheels is conveyed in a race a distance of a mile and quarter, and falls a distance of 120 ft. through two pipes 22 and 18 in. diameter. When full this race carries about 636 cu. ft. per minute. The power absorbed works out at 0·75 effective horse power per ton crushed.

In June last the working cost was 20s. 4d. per ton for 4208 tons crushed. The width worked averaged 29 inches.

MINING ON THE COAST OF BRITISH COLUMBIA

By PERCY WILLIAMS.



EIGHTEEN months since, encouraged and stimulated by promising discoveries in the Portland Canal district, the mining industry of British Columbia began to wake up after its ten years' nap following the Golden Cache fiasco and the Whitaker Wright boom. This awakening was quickened by a temporary dullness in Vancouver real-estate operations, thus enabling an extra large proportion of land speculators and brokers to participate, with variable sincerity and judgment, in the exciting business of bonding prospects, organizing companies, and selling stock. During this season of artificial prosperity some seventy incorporations were effected, chiefly concerned with the Coast and Portland Canal districts.

Of these promotions, a year and a half later, it may be safely stated that half-a-dozen

have proved successful in that they have developed prospects from the speculative stage to the point where they began to exhibit the "ear-marks of a mine." Of these lonesome half-dozen youngsters four or five have made spasmodic ore shipments, two or three have become mines of real merit, and none have paid dividends as yet.

The Marble Bay mine on Texada Island still apparently remains the sole profitable producer along 500 miles of coast line, with the possible exception of the Britannia mine on Howe Sound and two or three private leases.

The Portland Canal Mining Co.'s property, under able management but handicapped by lack of funds and over-capitalization, gives promise of soon becoming a regular and profitable shipper of ore and concentrate; and the same may be said of the Red Cliff, although the reports of the latter company have always lacked the comprehensiveness of those issued by the management of the Portland Canal. The Red Cliff is about to become a shipper of chalcopyrite ore, but no concise statement has been made public regarding probable tonnage and grade of ore as developed by the 1100-ft. cross-cut and the 400-ft. rise. The Glacier and Stewart properties in the same district are prospects located upon strong veins of low-grade concentrating ore of commercial width, which is more than can be said of the majority of locations made in that district during the recent boom.

Further down the coast, at Observatory Inlet, the Granby Consolidated people have been drilling and prospecting in a business-like way some great outcrops of pyrrhotite and chalcopyrite, which promise to furnish the low-grade nucleus for another smelting enterprise.

Back of Prince Rupert, around Hazleton in the Bulkley valley of the Skeena river, interesting discoveries of silver-lead ores have been made and some new coal areas located. The completion of the Grand Trunk Pacific Railway now being built through this district should enable some of these prospects to become productive mines. So far as known no notable discoveries of large low-grade argentiferous lead veins have been made, the majority being small galena veins assaying high in silver. The part of the Province opened up by this most northern of trans-continental roads is most inviting to prospectors and it will be surprising indeed if the next two years do not witness the opening up of some healthy rivals of the old-time producers of the Kootenay.

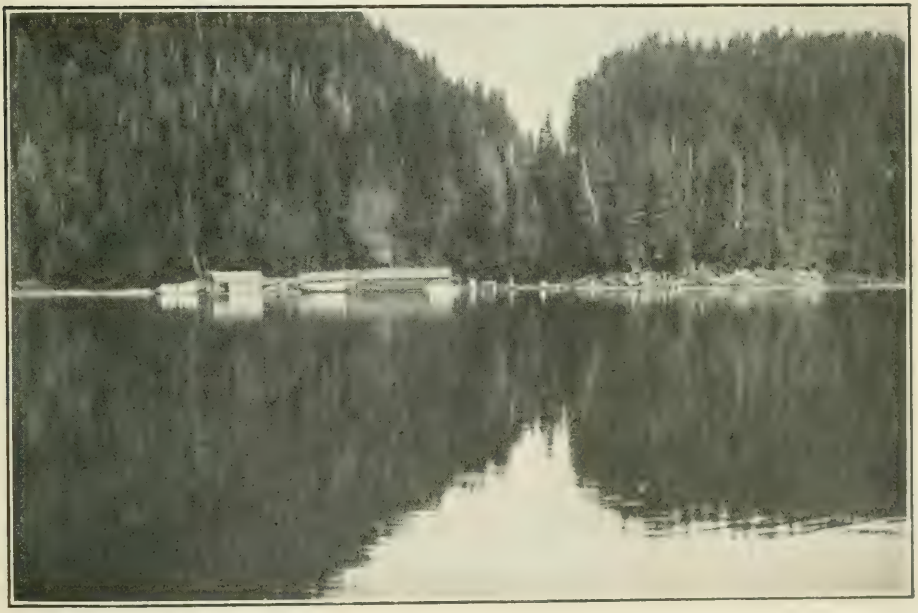
Just below the mouth of the Skeena at Princess Royal island the Surf Inlet mines are believed to be of great value and long life, limited development to date having proved generous width and large average gold contents. There are probably no new gold prospects along the coast that can approach in promise that of the Surf Inlet properties for the same amount of development.

On the Queen Charlotte islands, 60 miles off the British Columbian coast, considerable prospecting has been done along the shore, but so far the timber-cruisers seem to have had the best of it as far as penetrating to the interior of the island is concerned. Much coal land has been staked and several coal companies organized that have done more advertising of stock than they have of boring for coal. The occurrence of coal here has been generally known for 50 years, and is of wide distribution on the Queen Charlotte group, but little or no drilling has been done to determine the extent of the faulting and disturbance caused by the excessive igneous intrusions in this area.

At Skidegate Inlet, on Queen Charlotte island, is located the Ikeda mine, formerly a producer of consequence, which was sold by its Japanese owners a year ago and has since been drilled by a Vancouver syndicate that subsequently made an unsuccessful effort to finance the property, presumably upon the results revealed by the diamond-drill holes, although their prospectus did not detail the results of boring operations.

Farther south and east of the Coast range, on the mainland, in the Eastern Nanaimo and Western Clinton divisions, in the vicinity of Chilco and Tatlayaco lakes, several gold, silver, and antimony discoveries are reported as occurring along the general contact of the Coast range plutonics and eruptives with the sedimentary rocks of the interior divisions. The region is extremely favourable to the existence of auriferous veins but it has been little prospected, being only accessible by a round-about journey from Vancouver of some 500 miles, mostly wagon-road and trail. When the Provincial government builds a trail from tide-water at the head of Bute inlet to Tatlayaco lake, 60 miles, there will be more prospecting in this area. Indeed, this condition of inaccessibility from adjacent tide-water prevails all along the immediate interior country comprising the eastern slope of the Coast range. Numerous and deep salt-water inlets and fiords indent the coast-line for miles, cross-cutting, in some cases, almost to the

THE COAST RANGE OF BRITISH COLUMBIA.



LOGGING CAMP ON MACKENZIE SOUND, B.C.

backbone of the Range. Yet the rivers that define the passes and clefts in this lofty barrier of granite mountains find their way through miles of impassable box canons and thence westward and downward through the almost impenetrable bush and timber to salt water. Thus the prospector fresh from Tonopah, Goldfield, Arizona, the Australian bush, and the South African veldt, balks at the coast-range barricade of the British Columbian mainland and will continue to leave it alone until the Provincial government lends a hand or the aeroplane becomes perfected—as either one or the other is a necessity in the rapid development of the guarded interior adjacent to and yet so far from the coast. The interior of British Columbia is one of the few unexplored areas of North America where a white man can live, and its geological conditions are much more favourable for the occurrence of the precious metals than upon the western or sea-ward slope of the Coast range, where there is less area of acid porphyries and older sedimentaries and more of broken, distorted limestone, slate, schist, and unfissured granite.

Farther yet to the south along the coast near the United States boundary, and 80 miles inland from Vancouver lies Steamboat mountain, at the headwaters of the Skagit river. A year ago this section was the scene of reported fabulous gold strikes in formation "just like Goldfield Consolidated." These reported strikes caused an immediate furore among wide-awake Vancouver promoters. During the winter providential snow-falls delayed reputable investigations and it was only the coming of the glad spring-time that enabled Steamboat mountain to be classified with the famous "mountain of gold" discovered and undiscovered again at Bear river above Stewart a year ago.

Vancouver, dyspeptic already from a too steady diet of premature mining booms, needed only the Steamboat Mountain fizzle to deliver the last puncture to her cherished dreams of mineral supremacy. This "mineral supremacy" seems bound to come but not until the Coast country is systematically explored with the diamond-drill and the interior districts are rendered more accessible to tide-water by means of railway lines. The Government has been generous in its appropriations for roads and trails, but the country is large and the agricultural interests are clamouring loudly for attention, too; therefore development of transport facilities will be slow. Causes of mining failures in the past in accessible districts are largely due to erratic orebodies and insufficient use of the diamond-drill, combined with the reluctance or inability of operators to provide either for high-class engineering talent or sufficient capital.

Melting Metals at the Mint.—In the yearly report of the Master of the Mint particulars are given of the new gas furnaces used for melting metals. Many experiments had been made with electric and oil furnaces when a change from coke furnaces were first contemplated, but these were not found so suitable as those using gas. In the experiments with ordinary town gas a variety of systems were tested, involving the use of gas at ordinary and high pressures, combined with variations in the pressure of the air. The burner ultimately adopted was made by S. N. Brayshaw, of Manchester. For the Brayshaw burners in use at the Mint the gas is taken at the ordinary pressure in the main (about 3 in. of water), and mixed with air from a powerful blowing-engine at about 2 lb. pressure. With care the noise of these burners can be reduced sufficiently to be unobjectionable. The furnace linings compare favourably with those hitherto used for coke in regard to endurance, and the crucibles used for gold are found to last longer, each crucible serving for an average of eighteen heats, as against twelve when coke is used. The adoption of gas as a fuel in place of coke has been accompanied by several incidental economies, and it is interesting to note that the present charge for fuel averages about $4\frac{1}{4}$d. per cwt. of standard gold bullion, as against 7d. when coke was used. It should be added that the fuel needed to warm the furnace in the morning has been eliminated; but, including this, the cost rarely exceeds 5d. per cwt. on a day's work. During 1910 the Mint installed sixteen gas-heated furnaces, each capable of taking a 400-lb. crucible, and fired with Brayshaw gas-burners. These sixteen furnaces have a maximum capacity of $2\frac{3}{4}$ tons of sterling silver, or $2\frac{1}{4}$ tons of bronze per melt, and four melts of silver, or three of bronze, can be made in an ordinary working-day of 10 hours. Five furnaces similarly gas-heated, but of a smaller size, are in use for melting gold. It will be seen that a substantial saving in cost of fuel has been effected by the use of gas. The incidental economies are still greater. The cost of carting and handling both coke and clinker is saved, and the room formerly required for the storage of them is set free. The expenditure on crucibles, which is a large item, has been reduced by 33%.

OIL INDUSTRY OF ROUMANIA

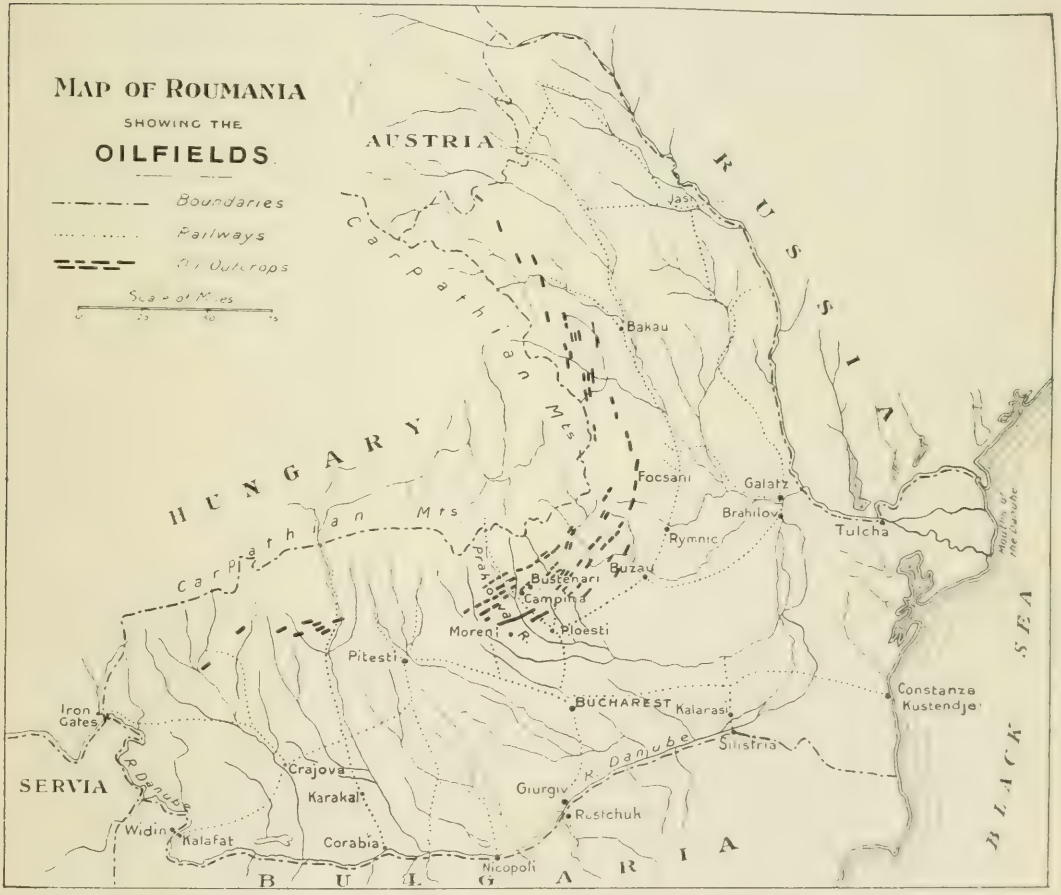
By R. C. N. TWITE.

HAVING regard to the large amount of capital now being invested by the public in oil companies, it is surprising that so little attention has been paid to Roumania.

Geographically, this country is well situated for exporting oil. It is bounded on the east by the Black Sea, with the port of Constanza, and on the south by the Danube, with the port of Galatz. A complete system of railways traverses the country. From London it takes about four days to reach Bucharest, either by way of Berlin or Vienna. The service is good, and a journey can be made without discomfort. From Bucharest it is only a couple of hours run to the oilfields in the Prahova district, which at present produce the bulk of the Roumanian oil.

The extent to which this oil industry has grown is shown by the following official statistics:

Year	Tons	Year	Tons
1870.....	11,649	1908.....	1,147,727
1890.....	53,300	1909.....	1,294,483
1900.....	250,000	1910.....	1,352,289
1905.....	614,870		



From the above figures it will be seen that the production has more than doubled during each quinquennial period since 1900.

In comparison with the world's output of oil, this production does not seem remarkable, but it must be remembered that the result is obtained from comparatively shallow borings. What the annual production will be when the deep wells are drilled is for the future, but if the deep Galician wells are any criterion, then

Roumania will take a high place among oil-producing countries.

The Government returns of last year show that Roumania exported oil and oil products to the value of over 40 million francs or roughly £1,600,000. This large sum was obtained from the export and sale of 581,256 tons, made up as follows :

	Tons
Crude oil, residue, and mineral oils	116,223
Petrol, illuminant, and distillate	339,282
Benzine, crude and refined	125,751

Each of these products shows an increase as compared with the previous year. The most striking was shown by the crude oil, residue, etc., which mounted from 49,715 to 116,223 tons, or more than doubled.

The oldest accounts show that oil was extracted in the Buzeu and Moldavia districts, which form the northern part of Roumania. There the oil is got from hand-dug pits, which are oval in shape and lined with wickerwork to keep them open. These pits often have a depth of 200 metres. They still continue to yield oil, but have been quite eclipsed by pits in the Prahova district. Here the method of sinking is quite different. The pits are usually square shafts one metre long and one metre wide. They are lined with oak staves one metre long by 14 cm. wide, costing at present 24 francs per hundred. The cost of sinking varies with the depth. They are sunk under contract by peasants who specialize in this class of work. Owing to gas and quicksand, fatal accidents are common.

This method of winning the oil has now been superseded by mechanically drilled borings which go to much greater depths than is possible with hand-labour. The systems now used are the American cable, and a modification of the Canadian system with light iron rods. When a site has been chosen for the new boring, and the necessary permission obtained from the Department of Mines, a pit is dug. The depth may be anything from 30 to 100 metres according to the ground and the requirements of the operator.

If only a shallow depth is needed, then an ordinary windlass is rigged to haul out the dirt and lower the workmen. To obtain ventilation, a large blacksmith's bellows is fixed at the side of the pit, and from its nozzle the pipes, made of tinned iron, are extended into the pit. As the depth increases, more piping is added.

For a depth of over 30 metres, a horse-whim is used in the place of a windlass, and if the gas is strong, two bellows may be worked to supply ventilation. To supply light to the miner, a mirror is fixed so that the rays of the sun are reflected down the pit. The miner has a safety line lashed around him so that in case he becomes 'gassed' or unconscious, he can be immediately hauled to the surface. The timbering is done from the bottom as the work proceeds, the miner excavating on one side at a time, putting in a stave and going round and round.

As soon as the required depth is reached, the derrick is erected, machinery installed, and drilling commenced. It is usual to commence the bores with casing having a diameter of 400 to 500 mm. The casing used for the first two strings is rivetted, and the rest is hermetically sealed. The rivetted casing is bought in the country, but the hermetical is imported from Germany.

In the Moldavia, Buzeu, and northern parts of Roumania, the land is held by large owners, and the estates are extensive. In the Prahova district, the land mostly belongs to peasants, whose original holdings were fairly large, but owing to division among their descendants, and through inter-marriage, these holdings have been subdivided into plots of one, two, and three acres. When the land was distributed amongst the peasants, a map was made. This map, however, has not been brought up to date, and great confusion has ensued.

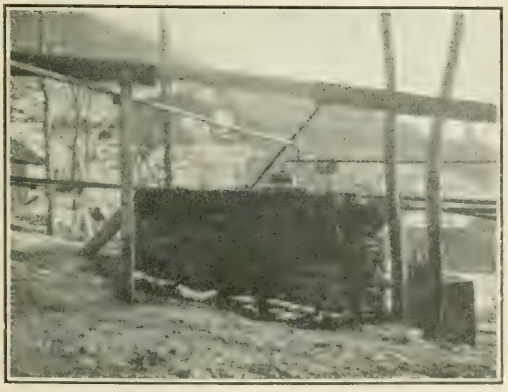
These peasant proprietors are not allowed to sell their land to foreign subjects or companies, so they lease their mineral rights for terms of 29 years and less. Granting of leases has led to a great deal of fraud and lawsuits, as often the peasant sells his rights two or three times over. The concessions are merely contracts, and as such are entered in the official books of the Prahova Tribunal ; there is, however, no official examination to prevent fraud. To minimize this, the Government in 1904 passed the Consolidation Act, whereby an examination is made on the spot by the officials, and if it be found that the particulars given in the concession are correct, the plot is consolidated to the buyer, and the title made absolute. To consolidate a concession, the following is the procedure : First, a petition has to be presented to the district Tribunal, praying that the plot be consolidated at the same time, the necessary taxes, fees, and costs being paid. The judge then has to appoint a day for the public investigation, not earlier than one month or later than two months. During this interval, the petitioner has to deposit a plan of the plot at the Tribunal. Fifteen days before the date fixed, an official notification with full par-

ticulars must be published in the official *Moniteur*, in the local paper, and it must be cried three times in the commune where the plot is, and posted in the mayor's court. Immediate neighbours must be subpœned to attend the investigation, as well as the contestants. On the appointed day, the investigation is held in the commune, where the plot is; the following

Boring with Drilling Bit.

Government officials being in attendance: senior President and senior Secretary of the Tribunal, county Judge of the district, senior Inspector of Mines for the district, the Mayor of the commune, his Secretary and Precepteur.

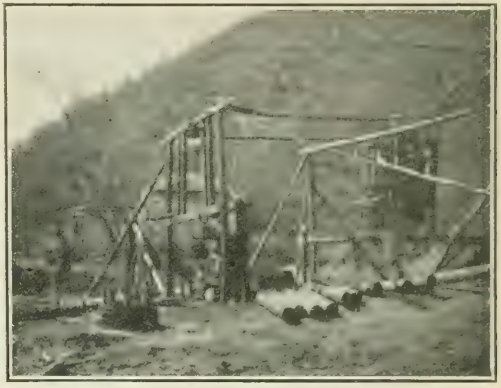
The plot is visited, evidence is taken, and the verdict given in three days. If the petitioner has a valid title, then the concession is



Wooden Reservoir.

consolidated to him, and an act drawn giving him a good title. All concessions and consolidations are published in the Government official publications, which clearly state who are the owners, the concessionaires, terms of the concession, and official numbers.

It cannot be too clearly pointed out that the concessions granted are, until consolidated by the Government officials, simply contracts, which can be broken by the peasants, and often are, and that redress is difficult to obtain. These concessions give right of entry to the land and specify the amounts to be paid for damage to trees, houses, and roads.



Sinking a Hand-dug Pit.

Nearly all the promising oil-land has been taken up by speculators who have got it cheaply from the peasants. Speculators then sell it to the operating companies at a handsome profit, and fix a royalty on the oil produced. This royalty goes as high as 10% on the total production. The Government also charges a royalty of 1% on all oil produced.

Roumanian Peasants.

The oil measures in Roumania are nearly all found in the anticlinal folds of Tertiary strata, which are parallel to the Carpathian mountains, and outcrop in succession from the mountains toward the Danube plain. On

the Prahova plains, these anticlines are known to exist, but are covered over by recent deposits. In the hilly country the strata are exposed and can be traced. In this district, the anticlines are parallel to one another, and have an east-west direction with a tendency to turn toward the north with a variation of from 10 to 30 degrees, the eastern ends having the greatest variation. Some of the anticlines can be traced over long distances, as for example, the great Campina group of parallel anticlines, extending from Draganeasa to Apostolache, a distance of 60 kilometres.

As is usual in other regions, the maximum quantity of petroleum is found in approaching the anticlinal axis. The really developed oilfields at present producing the bulk of the Roumanian oil are: Campina, Bustenari, Moreni, and Boicoi-Tzintea. Besides these, a large number of smaller fields, whose area and capabilities have not yet been determined, have demonstrated from trial borings that they can produce oil in payable quantity. For example, Apostolache, Filipeshti de Padure, and Vulcanesti.

The Campina oilfield was the first to be developed on modern lines, and for many years was the premier oilfield of Roumania. It is notable for the number and productiveness of its great gushers and for the reliable yield of its wells, over its entire area and during many years. The petroliferous strata are of Lower Pliocene and Upper Miocene age with two principal oil-horizons.

The Bustenari is a collection of fields that continually expand. It is the direct continuation of Campina to the east. For many years it was the greatest oil-producer in Roumania, but the yield has sensibly diminished during the last three years, owing to the new extensions not being so rich as the central portion. The geology is complicated. The petroleum is yielded by the Meotic (lowest Pliocene) and the Upper Oligocene strata. The wells yield a steady production.

The Moreni oilfield last year secured first place for total production, and for the last three years it has also yielded the highest production per well. This field has as yet a limited area, and many trial wells sunk have encountered thick deposits of salt. These wells have been completely barren.

The Boicoi-Tzintea, eight miles south of the Campina anticlines, is a system parallel to the Campina. From later investigations there seems to be two anticlines, the strata dipping at a high angle. Faulting is noteworthy. Hence wells right off the ridges have to go deep to strike oil. But the wells are prolific producers of an oil inferior to that of Campina and Bustenari.

The following table shows the approximate annual yield per well in different parts of the Prahova district.

Oilfield	Wells 1909 Number	Wells 1910 Number	Yield per well 1900 Tons	Yield per well 1910 Tons
Campina	99	112	3143	2976
Bustenari	464	467	848	683
Moreni	50	48	7395	7135
Boicoi	10	14	1974	1912
Tzintea	10	22	11616	5274
Pacuretz	1	3	1360	348
Bordeni Parsaui	3	3	1687	1738

Most of this oil is obtained by pumping, but in certain fields large gushers exist. These gushers, however, die away in from 6 to 12 months and then the wells require pumping. As the oil is obtained from the wells it is run into settling-tanks and thence into storage-tanks. In many cases the tanks are built of wood, with a retaining wall of earth or clay, covered by wickerwork. This earthen wall serves as a protection for the wood against sudden changes in the climate, and also retains the oil in case of fire.

The measuring and storage tanks are constructed of iron and steel. The various companies convey the oil through a network of underground pipe-lines to the railway and thence to the refineries. The larger refineries have also their own pipe-lines and buy direct from the producers. In the newer fields the pipe-lines will have to be constructed and concessions obtained from the Government.

The charge for conveying the oil is according to distance, besides a fixed allowance of $1\frac{1}{2}\%$ for impurities and water. On receipt of the oil by the pipe-line company, it is measured and a coupon given to the producer. This is easily negotiable and is as good as cash. Contracts are made for the whole production from a well or plot for months in advance. The pipe-lines are laid along the roads as much as possible. Tank-cars are also used. Over 2000 of these are now in use on the railway systems for conveying oil and refinery products.

The Roumanian refineries are able to treat over 2,000,000 tons of crude oil per annum.

Some of the refineries are enlarging their plants. The products obtained may be classified as follows:

(1) crude and rectified benzine;
(2) lamp and distilled petroleum;
(3) residues, crude gas, and mineral oils.

In a consular report for 1910 it is stated: "The exports of petroleum increased by about 134,000 tons in 1910, the increase being prin-

cipally in refined oil and residues. France is the principal importer, the United Kingdom is second, and Egypt third. The quantities exported in bulk through the State petroleum reservoirs at Constanza were as follows:

	1909 Tons	1910 Tons
Benzine	93,924	93,327
Refined oil	137,624	236,109
Distilled (including crude oil)	68,173	86,949
Residues	6,212	58,626
Total	341,933	475,011

In addition to the exports in bulk, about 30,000 tons were exported in tins and barrels. No reliable figures are obtainable regarding the countries of destination."

MINE SAMPLING

By S. F. SHAW.

IT would be impossible to lay too great stress on the importance of systematic mine sampling, and recording of the assays, whether it be during development work alone, or whether regular mining operations are being carried on. It is not enough to take many samples, for unless there be a simple manner of recording these same samples much of their value would be lost, especially after a period of a few months. Properly kept records would be of great value even after the lapse of several years, whereas a mere list of assays might not only be useless but even misleading.

CYANIDE PLANT AND MILL OF THE MONTEZUMA MINES OF COSTA RICA.

It should be borne in mind that a great number of factories and industries employ only oil-fuel, as crude oil, residue and benzine are procurable locally from the refineries. The increase in the employment of this fuel is becoming more pronounced every year. More than half the locomotives on the railways are fitted for oil consumption. Factories, passenger steamers, and river craft also employ it.

The Government is doing a great deal to foster and aid the petroleum industry. Although there is a high protective duty on most imports into the country, quite a long list of machinery and appliances required for the industry are permitted to enter free of duty.

A project is in hand for linking the oilfields with the port of Constanza by a long pipe-line. This would give the industry a great impetus.

In this article a description of the method in use at the Montezuma Mines of Costa Rica will be given together with the necessary illustrations. All records are kept on loose-leaf forms, as this permits the keeping of a continuous record for several working-places without requiring the service of several volumes. When the binder is filled those records that are not in current use for reference are removed and filed in special cases.

During development work, the faces of drifts, rises, and winzes when in vein-matter are sampled daily, taking a sample weighing from 25 to 50 pounds. A numbered tag is placed in the sample-sack, which is then sent to the assay-office. A concise description of the sample

TABLE I.—MONTEZUMA VEIN, NO. 8 TUNNEL, RISE NO. 2.

Date	Number	Description	Width Ft.	Gold Oz.	Value per Ton
Sept. 1	15	2 ft. above tunnel level	5·4	0·60	$12·00
,, 3	130	13 ,, ,, ,, ,,	5·0	1·24	24·80
,, 8	518	37 ,, ,, ,, ,,	5·0	0·30	6·00

TABLE II.—MONTEZUMA NO. 8 TUNNEL, NO. 8 STOPE.

Date	Number	Description of Sample	Width Ft.	Gold Oz.	Value per Ton
Sept. 1	1052	7 ft. east of chute No. 3½ 17 ft. up	8·5	0·64	$12·80
,, 14	1166	11 ft. west of raise No. 2 23 ,, ,,	16·0	0·26	5·20
,, 30	1300	Over chute No. 3½ 36 ft. up	11·0	0·60	12·00

TABLE III.—ASSAYS OF CAR-SAMPLES.

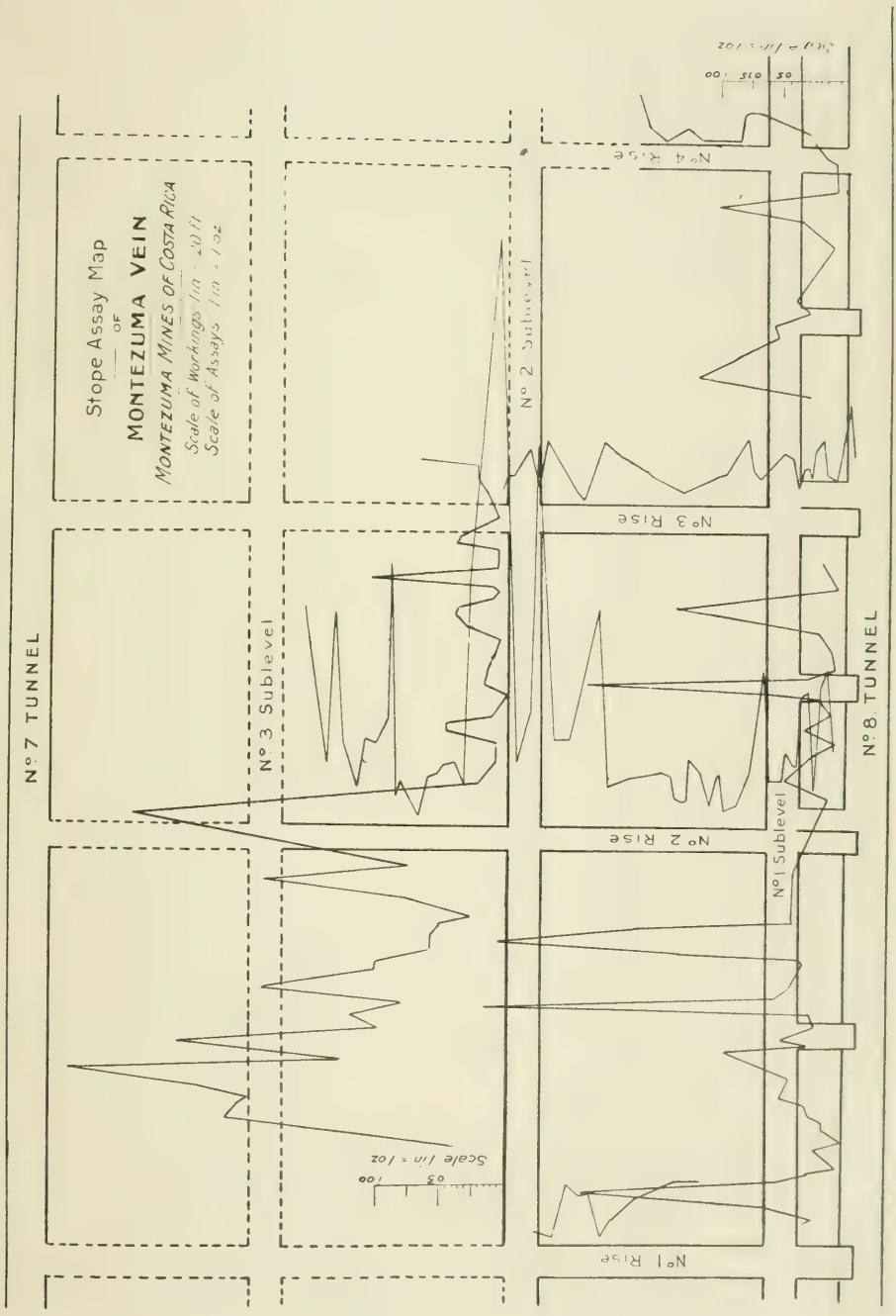
Date	Number	Chute Number	Cars	Gold Oz.	Per Ton Value
Sept. 5	650	1	10	0·48	$9·60
,, 5	651	2	16	1·14	22·80
,, 30	962	1	6	0·40	8·00
,, 30	962	2	17	0·90	18·00
,, 30	964	3½	10	0·28	5·60

TABLE IV.

Chute Number	Tons	Per Ton Value	Gold Value
1	6	$8·00	$48·00
2	17	18·00	306·00
3½	10	5·60	56·00
Total for the day	33	—	410·00
Previous Total	1530	—	14425·50
Total to Date	1563		14835·50
Average	52·1	9·49	494·50

TABLE V.—ASSAYS OF MILL-FEED SAMPLES.

Date	Number	Hours	Gold Oz.	Per Ton Value	Total
Sept. 29	98	48	1·08	$21·60	1046·40
,, 30	105	88	0·74	14·80	1302·40
Total	—	132	—	—	2348·80
Previous Total	—	2031	—	7·39	16079·96
Total to Date	—	2163	—	—	18428·76
Average to Date	—	72·1	—	8·52	—


Stope Assay Map
OF
MONTEZUMA VEIN
MONTEZUMA MINES OF COSTA RICA
Scale of Workings 1in = 20 ft
Scale of Assays 1in = 1 oz
No. 7 TUNNEL
No. 3 Sublevel
No. 2 Sublevel
No. 1 Sublevel
No. 8. TUNNEL
No 1 Rise
No 2 Rise
No 3 Rise
No 4 Rise
Scale 1in = 1oz
03 1.00

is noted on the stub retained in the sample-book and numbered to correspond with the tag placed in the sack. As soon as the sample-stubs are turned in at the office, usually at the close of the day, the description is entered in the assay-ledger, with date and number of the sample, and as soon as the assays are received from the laboratory the results are entered in the ledger opposite the corresponding number. Table I illustrates this clearly.

In addition to the assay-record, all development samples are plotted graphically on the assay-plan and shown on the section of the Montezuma No. 8 stope. The ordinate is plotted above the straight line representing the roof of the drift on a scale of an inch to the ounce, and at the point where the sample was taken. In this way the mind can grasp at once the relation between several hundred assays, which would be impossible when only reading the figures. After any particular piece of development work has been completed the assays are averaged over the entire distance, taking into account, of course, the width of the vein where the samples were taken. This average is then available for comparison with the car and stope samples from the same place.

Samples are taken daily as the stope advances, numbered, and recorded in the same manner as the development samples under an appropriate heading as shown in Table II.

Car-samples are also taken and thrown into a box numbered to correspond with the chute from which the ore was drawn, at the scales where the ore is weighed before going to the mill. These samples are tagged and entered on the car-sample sheet as shown in Table III.

When the assays of the car-samples are received from the laboratory they are entered on Table III. and also entered in another record on which the total gold contents is computed as shown in Table IV.

The totals are carried forward daily in order to indicate the average of the ore delivered to the mill for the month up to any specified date, and also to show the average at the end of the month without it being necessary on the last day to go over all the records and make all of the computations at one time.

Feed-samples are also taken at the stamps, which crush the ore, drawn from the Montezuma No. 8 stope, and recorded in the same manner as the car-samples from the mine, and entered as shown in Table V. The assay is multiplied by the battery-hours, as this is approximately proportional to the tonnage, and the total so obtained at the end of the month is divided by the number of battery-hours, giving the average assay of the feed for the month.

It is seen that the totals can be carried forward daily for these samples so that it is easy at any time to compare the mill-samples with the car-samples. At the beginning of the month these samples might be considerably far apart, as there is always a certain amount of ore left in the bin from the previous month, but this difference largely disappears within 8 or 10 days and by the end of the month the two samples should check within reasonable limits.

In the examples given above, actual results are quoted as obtained for the month of September. The development samples for 50 ft. of four rises and 150 ft. along the level of Montezuma No. 8 stope at intervals of $2\frac{1}{2}$ ft. averaged $8·85 per ton, which is very close to the average of the mill-feed samples. The stope-samples averaged $10·25, but these are not so representative of the average grade of the ore as they are not taken at uniform distances both vertically and horizontally, but are useful in noting where variations occur in the grade of the orebody. The car-samples are higher in value than the mill-samples, on account of the tendency to get too great a proportion of the fine when breaking the sample.

Institute of Metals. — The next half-yearly meeting of this Institute will be held on January 16 and 17. William Gowland, the new president, will deliver an address on 'Copper and its Alloys in Early Times.' Among other papers to be read and discussed are the following: 'Properties of Certain Copper Alloys at High Temperatures,' by Guy D. Bengough; 'The Influence of Oxygen on Copper containing Arsenic or Antimony,' by R. H. Greaves; 'Experiments on a Zinc-Antimony Alloy,' by Carl Benedicks; 'The Nomenclature of Alloys,' by W. Rosenhain. Mr. Benedicks' paper is illustrated in colour, an innovation which might with advantage be adopted wherever possible in connection with the portrayal of metallographic effects. The Institute has only been in existence for three years, but it has been phenomenally successful both from the point of view of the quality of the membership, and the excellence of the papers and discussions. During the last few weeks so great a number of applications for membership have been received that special councils and ballots are being held so as to complete the elections before the forthcoming meeting.

PRÉCIS OF TECHNOLOGY

Tin in German Southwest Africa.—The *South African Mining Journal* for October 21 contains extracts from the report of E. Jorissen on the geology of a new tin district recently discovered near the line of railway between Swakopmund and Windhoek, German Southwest Africa, and 94 miles from the coast. The deposits have been traced over a tract of country measuring six square miles, in an undulating flat round the southern base of Erongo mountain. This mountain is a boss of granite intruded through schist and quartzite. The schist is a quartz-mica schist containing biotite with some muscovite, and the quartzite only differs by the larger amount of quartz grains; in some places the two merge into each other, and at other places are strongly contrasted. The strike of the beds averages N 20° E and the dip 40° to 60° south. Numerous dikes of felsite, fine-grained granite, and granite-porphyry cut through the strata, and they can be generally traced to the main granite intrusion. Nearly all the granite dikes are greisenized. There are several phases of intrusion, the principal ones being (*1*) the main intrusion with which are associated the numerous detached intrusions of pegmatite and many parallel greisen dikes; (*2*) a granite-porphyry stage in which the later dikes cut through the previous group; (*3*) greisen dikes cutting through the porphyry; and (*4*) red granite dikes not greisenized. Each stage appears to be connected with tin, but the lodes in the neighbourhood of the porphyry dikes seem to be the most promising. The best samples have come from coarse white pegmatite. The lodes are notable for the unusually large crystals of cassiterite. One mass of cassiterite is said to have weighed 500 lb. Dr. Jorissen does not commit himself to a definite opinion as to the eventual average ore, as the workings are too shallow as yet, nor have the veins been followed sufficiently to prove continuity, but in view of the interest caused by recent discoveries in Cape Colony near the Damaraland border, and the development work done by the De Beers company not far away, his report is of importance. It is stated that the property is to be floated immediately at Johannesburg.

Diamonds in British Columbia.—In the spring of this year official announcement was made by the Canadian Geological Survey that diamonds had been discovered in the peridotite of the Tulameen district of British Columbia. This was the first recorded discovery of diamonds in Canada for which the Survey can vouch, and the second instance of their being found in the original matrix on the North American continent, the other being in Arkansas. Fuller details are now given by Charles Camsell in the September issue of *Economic Geology*. The exact locality of the discovery was on Olivine mountain to the south of the Tulameen river, 30 miles from the United States boundary, and 100 miles east of Vancouver. For some years, placer mining has been conducted in the Tulameen district, but no diamonds were discovered in the gravels, though the Survey, knowing of the existence of peridotite, had drawn the attention of the miners to the possibility of diamonds being present. A year ago the officers of the Survey found masses of chromite in the peridotite and sent specimens to R. A. A. Johnston, their mineralogist, for examination. In the course of his analysis, Mr. Johnston obtained a residual product from fusion, that proved to be diamonds. Confirmatory tests were made subsequently by G. F. Kunz. As far as has yet been ascertained, the diamonds are associated only with the chromite, which occurs in small bodies erratically distributed in the peridotite. The diamonds are small but some are of excellent quality. They are difficult to extract from the rock without becoming broken, and even after extraction, they break of themselves, owing to inclusions or to internal strains set up by release from surrounding pressure. The largest size so far found is not greater than a pin-head, but these split on exposure, and the largest that was permanent measured only 0·3 mm. It will be seen therefore that the discovery is of geological rather than of commercial interest. Mr. Camsell describes at length the scientific aspects of the discovery.

Ores in Sandstone and Shale.—In *Economic Geology* for September, Waldemar Lindgren contributes a paper on the occurrences in various parts of the world of ores of copper, lead, vanadium, and uranium in sandstone and shale far away from igneous rocks. These ores appear to have a common mode of origin, and he discusses their probable genesis. The ores are usually of low tenour, and in the majority of cases are not at present of any commercial value. The primary ores in such deposits are chalcocite with small amounts of bornite, chalcopyrite, and pyrite; galena; roscoelite (a vanadium mica); and carnotite (vanadate of uranium). Small amounts of nickel, cobalt, molybdenum, barium, and selenium compounds are often found. In some deposits all these minerals are found together, but usually they are segregated in such a way that one metal predominates. Little gangue is found accompanying, and is usually confined to calcite, barite, and gypsum. Where the deposits have been exposed to atmospheric action, the minerals are oxidized. The deposits are notably confined to formations belonging to the Permian, Jurassic, and Trias, and characteristic occurrences are connected with fractured or brecciated beds or where fossil plants abound. More rarely the ores are found in fissures in the same formations, where they were evidently deposited by ascending or descending atmospheric water. Occasionally the ores have been leached and carried downward into the lower strata. The occurrences of copper deposits of this type are mainly on the flanks of older continental areas containing pre-Cambrian copper deposits. The probability is that these rocks were weathered and the copper ore contained in the detritus leached by atmospheric water charged with salt and gypsum. On being carried to lower horizons the solutions would be concentrated, and the copper minerals precipitated by reactions with coaly vegetable matter or by the calcareous cement in the sandstone. Thus the deposits are distinctly epigenetic, and are not connected with ascending thermal waters. As regards the vanadium deposits, the occurrences are somewhat similar, but the association with carbonaceous matter is even more obvious. Mr. Lindgren reviews the principal deposits in various parts of the world. The Russian districts in Perm and the Southern Urals have long been well known for this class of copper ore, and more recently the deposits of the Akmolinsk district of Southern Siberia has become prominent. He also gives an outline of the known occurrences in Germany and the United States. The Katanga deposits is mentioned, but in the absence of information the author is not in a position to decide whether they come within this category. The Mansfeld cupriferous shales are not included, because the majority of geologists consider the copper minerals as syngenetic with the beds themselves. Mr. Lindgren also reviews the occurrences of vanadium and uranium in various parts of the world.

The Nissen Stamp in South Africa.—At the meeting of the Chemical, Metallurgical, and Mining Society of South Africa, held on October 21, P. N. Nissen read a paper on high-duty gravity stamp-mills. Our readers are probably aware of the fact that the Nissen stamp has been tried at the City Deep mill in competition with the ordinary heavy stamp. This paper gives the results of these tests, and also a general dissertation as to the advantages claimed for the author's design. The Nissen stamp is designed on the principle of 'one stamp one mortar-box'; each stamp is contained in a circular mortar-box, instead of five side by side in a box of rectangular section. The primary object of the design was to secure a more rapid discharge of the ore directly it is crushed fine enough; but it also has another important advantage, more recently recognized, in that it permits of the expansion of the heavy-stamp idea without involving the construction of massive foundations, frames, and moving parts. As regards the discharge, the screen-area can be made special design. In the design of the heavy 5-stamp battery, the strains set up limit the size of the mortar-box, so that if the weight of the stamps is to be increased, this cannot be done by increasing the diameter of the head, shoe, and die, but only by increasing the height of the head. Thus the centre of gravity of the falling weight is unduly raised, and the distance between the lower guides and the crushing faces is made greater than it should be. The Nissen stamp has a wider and shorter head, being 10 in. diameter for 2000 lb. weight, and owing to the form of the mortar-box additional weights can readily be fixed on the stem so as to compensate for wear. The greater width of the head also makes it possible to fit the shoe and die more securely. As the head of the stamp can be made in such substantial form, it is not necessary to have a long stem or a heavy tappet. Thus the height of the battery can be reduced and its stability thereby increased. The increased width of the head makes it possible to have a wider tappet and to place the cams

Test Number and Date.	1 June 23.		2 July 5.		3 July 17.		4 July 26.		5 Sept. 11.		6 Sept. 16.	
No. of Stamps and kind	4 Nissen	10, City Deep	4 Nissen	10, City Deep	4 Nissen	10, City Deep	4 Nissen	10, City Deep	4 Nissen	10, City Deep	4 Nissen	10, City Deep
Weight of Stamps, lb.	1932	1863	1927	1859	2245	1855	2237		1993	1775	1991	1773
No. of Drops per min	103	100	103	100	103	100	103		103	100	103	100
Height of Drop, inches	8¾	8½	8½	8⅜	8¼	8¼	8½		8¼	8⅜	8⅜	8⅜
Height of Discharge, inches	2⅜	2¼	2	2⅜	2	2⅜	2		2¼	2¼	2¼	2¼
Class of Screen	Tyler T.C.		Tyler T.C.		Sq.m. 14(·08)		T.T.C.		Sq. mesh wire		Sq. mesh wire	
Mesh of Screen	9	9	9	9	⅜in.	⅜in.	9		9	9	⅜in.	⅜in.
Width Aperture in inches	0·205	0·205	0·205	0·205	0·375	0·375	0·23		0·277	0·277	0·375	0·375
Length Aperture ,,	0·536	0·536	0·536	0·536	0·375	0·375	0·85		0·277	0·277	0·375	0·375
Dry Ore crushed, tons	180·86	192·75	180·25	192·12	193·88	206·66	191·7		185·32	194·53	185·7	191·2
Total Run in hours	44·43	25·33	39·0	23·166	31·70	21·83	37·28		37·29	22·28	29·52	18·85
Tons per stamp per 24 hours	24·47	18·26	27·73	19·90	36·69	22·72	30·85		29·81	20·95	37·74	24·34
H.P. per stamp*	4·09	4·21	4·09	4·21	4·95	4·21	4·95		4·23	4·65	4·23	4·65
H.P. hours per ton of ore crushed*	4·0	5·5	3·56	5·06	3·24	4·45	3·86		3·41	5·32	2·71	4·56
Lb. ore crushed per lb. falling weight per day	25·33	19·6	28·78	21·412	32·68	24·49	27·58		29·91	23·6	37·91	27·45
Ratio water: ore by weight	5·4 : 1	2·7 : 1	4·2 : 1	2·4 : 1	3·1 : 1	2·15 : 1	3·2 : 1		3·3 : 1	3·3 : 1	3·03:1	3·26:1
Consumption metal in shoes in lb. per ton crushed	0·129	0·145	0·139	0·24	0·198	0·187	0·122		0·147	—	0·112	0·08

No Competitive Test.

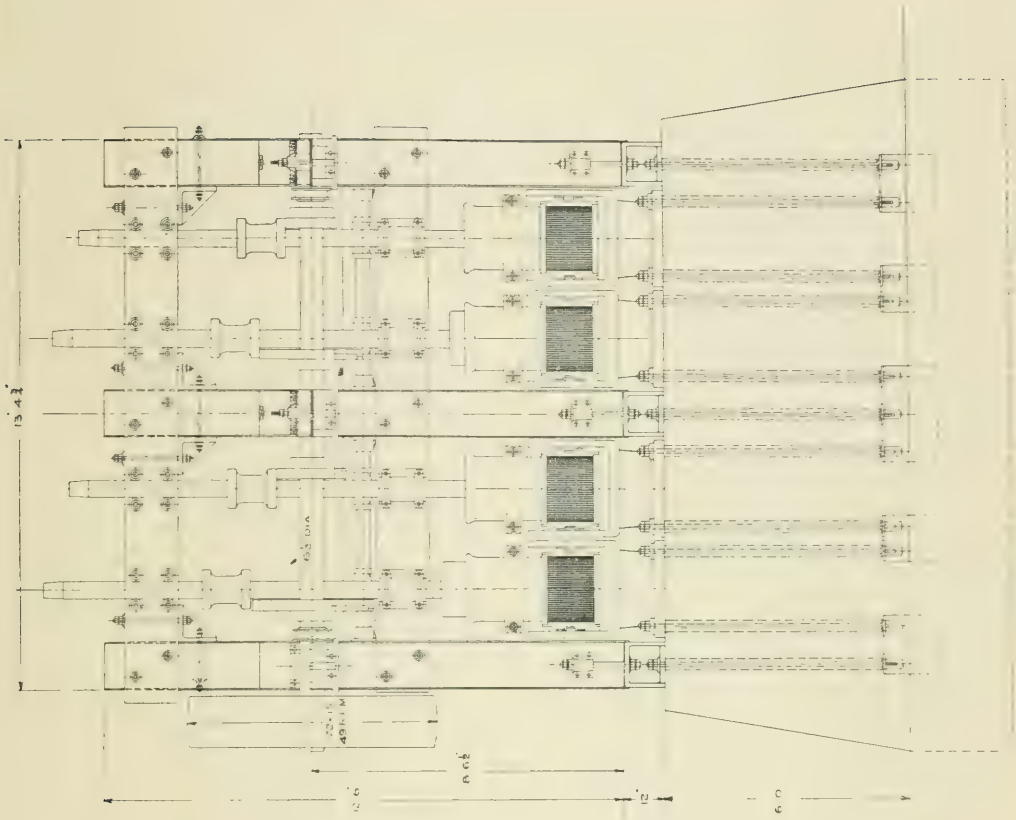
*Excluding Belt, Shafting and Motor losses.

Grading Analysis in Percentages.

Feed	+2	36·9	12·1	14·96	12·4	26·9	18·2	52·3		39·0	14·1	23·7	27·1
	+1½	18·6	14·4	14·50	11·35	18·75	16·0	14·5		19·7	18·0	20·9	17·1
	+½	15·1	20·2	20·40	19·35	19·3	18·15	10·4		15·0	21·3	18·8	19·1
	+¼	11·7	12·7	16·95	17·70	13·05	16·25	9·4		9·3	16·0	12·7	12·6
	−¼	27·5	37·9	33·20	39·20	22·0	31·4	13·4		17·0	30·6	23·9	24·1
Discharge	+60	65·2	63·4	64·9	63·4	67·24	69·33	67·3		66·6	66·5	70·7	70·7
	+90	8·3	9·1	8·46	8·70	8·62	9·09	8·75		9·9	10·2	10·1	10·3
	−90	9·7	12·0	8·46	9·10	10·84	9·82	8·55		8·8	10·9	10·2	9·2
	−200	16·7	10·7	18·10	19·5	13·3	11·76	15·4		14·7	12·4	9·0	9·8

much greater; the pulp at each fall of the stamp impinges at right angles on the screen, instead of following the usual whirling path; at each rise of the stamp the undischarged pulp is drawn to the centre and therefore into a position which will give the greatest efficiency to the next blow. The feed with a circular mortar can be arranged more conveniently for ensuring the delivery of the ore into the central axis of the crushing action; this fact, together with the suction of the rising stamp drawing the undischarged pulp to the centre, makes a more even distribution of the coarser pieces between the shoes and dies, which therefore wear more regularly. Coming now to the more advantageous construction of the various parts, it is clear that, with the line of blow being always in the central vertical axis, there is little or no twisting effect imparted to the mortar, as is the case where 5 stamps are falling in such an order as to obtain a whirling motion to the pulp. In the latter case the mortar-box has to be built strong to withstand the strain, the foundations have to be massive, and the bolts for fastening the box to the foundations have to be of nearer the cam-shaft bearings. The illustration shows the form in which the stamp has been adapted for South African practice. The stamps are arranged in couples, and two couples form a unit for driving. The stem is 5 in. diam. and 10 ft. high, and the centre of the cam-shaft is only 9½ ft. above the top of the foundation. According to this construction, the power required is 30% less and the weight of metal required is 40% less per ton of ore crushed.

The accompanying table gives the results of the tests at City Deep. These tests were made by the Central Mining and Investment Corporation and the report is signed by F. L. Bosqui, consulting metallurgist, and J. H. Rider, consulting electrical and mechanical engineer. The Nissen battery consisted of 4 stamps as illustrated, and the competing mill contained 10 stamps of the standard type. It will be seen that the power consumed per ton of ore varied from 2·7 to 4 hp.-hour with the Nissen stamp, and from 4·45 to 5·5 hp.-hour with the ordinary stamp. The ore crushed per pound of falling weight varied from 25·35 to 37·91 lb. with the Nissen stamp, and from



THE NISSEN STAMP-MILL AT CITY DEEP.

19·6 to 27·45 lb. with the ordinary stamp. By Stadler's method of computation, based on the grading analysis, the relative mechanical efficiency was 0·25 for the Nissen stamp and 0·19 for the ordinary stamp, an advantage to the Nissen by 35%.

Marketing Copper in the United States. — The *Mining and Scientific Press* for October 28 prints an article on the methods of marketing copper produced or refined in the United States. The United Metals Selling Co., that used to be the great Lewisohn organization, but is now owned by the Anaconda and Amalgamated Copper interests, is still the largest dealer in copper in the world, but the Guggenheim organization, the American Smelting & Refining Co., is running it close. We give below a list of the selling agents with the estimated amounts that each will handle in 1911.

	Pounds.
United Metals Selling Co. :	
Amalgamated	264,000,000
Lake mines	90,000,000
Arizona Copper	34,000,000
Greene-Cananea	46,000,000
Utah Consolidated	8,000,000
Pennsylvania Salt	5,000,000
Total	447,000,000
American Smelting & Refining :	
Utah Copper	100,000,000
Nevada Consolidated	65,000,000
Tennessee Copper	14,000,000
Ray Consolidated	10,000,000
Cerro De Pasco	48,000,000
Tacoma Custom Smelter	100,000,000
With other small items bring Total to	342,000,000
Phelps, Dodge & Co. :	
Copper Queen	112,000,000
Detroit	23,000,000
Calumet & Arizona	48,000,000
Total	183,000,000
American Metal Co. :	
Old Dominion	27,000,000
Shannon	14,000,000
Granby	10,000,000
East Butte	10,000,000
Teziutlan	12,000,009
Torreon	6,000,000
Ducktown, Fitzroy, and others	51,000,000
Total	130,000,000
L. Vogelstein (Aron Hirsch & Sohn) :	
United States S. R. & M. Co.	24,000,000
Orford	20,000,000
United Verde	40,000,000
Smelter products, imports, etc.	46,000,000
Total	130,000,000
Charles Raht :	
Calumet & Hecla	70,000,000
Other mines	8,000,000
Total	78,000,000
E. P. Earle, Beer, Sondheimer & Co., W. Parsons Todd — Total	18,000,000

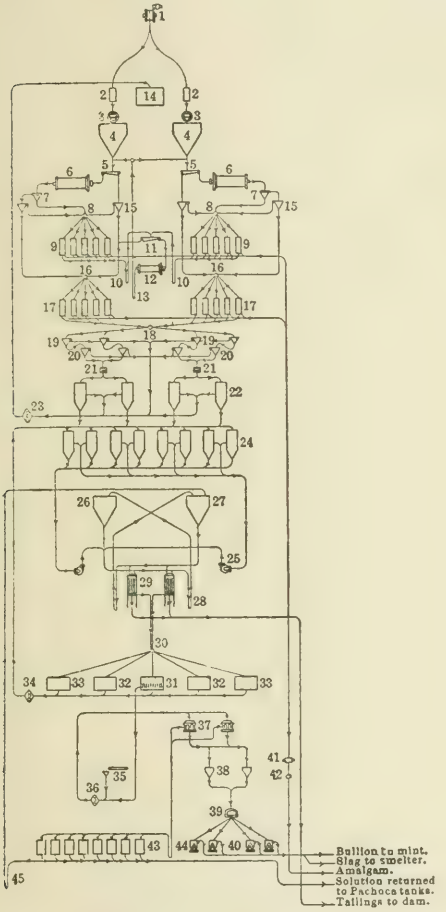
A number of mines sell their copper direct to users, accounting in all for 114,000,000 lb. during 1911. Of these, a number of Lake Superior mines account for 48,000,000 lb. It is of interest to note that the Miami proposes to market its metal direct, though as Adolf Lewisohn, who used to be head of the United Metals Selling Co., will be in charge of the sales department, the distinction between the two methods in this case is not marked.

A Strange Mineral.—At the October meeting of the Royal Society of South Africa, B. S. J. van der Riet read a paper describing the curious case of supposed discovery of a new mineral at the Dutoitspan diamond mine, Kimberley. The incident forms an excellent example of other things being in a mine besides the particular mineral for which search is being made. The substance was found in the pulsators and was forwarded to mineralogical experts at Cape Town University for examination. An analysis gave iron 71·3%, silica 20·03%, and carbon 8·41%. After much inquiry, the suggestion was made that the mineral closely resembled one of the residuary products in the manufacture of acetylene, and the fact that this gas is made on the spot and used in the mine helped to confirm the suspicion. Comparison was then made with lumps and pellets that settled in the lime residue from the generators used at the chemical laboratory of the University, and the physical characteristics of the two were found to be similar, as to hardness, colour, fracture, etc. The pieces varied in composition from iron carbide attacked by dilute acids, to iron silico-carbide attacked by hydrofluoric acid but not by hydrochloric or sulphuric acid. The discovery of the material in the pulsators had at first been hailed as a petrological fact that might help in the elucidation of the genesis of diamonds, and the real cause for its presence was naturally a disappointment to the scientists.

The Standard Tin Contract.—In our last issue we reproduced a table giving the results of analyses of well known brands of tin, made for the London Metal Exchange. We are informed that the figure for tin content in Williams-Harvey No. 4 is incorrect; the percentage should be 99·941 instead of 99·641 as given. This error is naturally regrettable, for it does injustice to the smelters. On referring the matter to the contributor of the précis, we find that he made the mistake of using the reprint of the table that appeared in the pages of *The Mining Journal* instead of the official circular.

Cyaniding Concentrate at Treadwell. — At the meeting of the American Institute of Mining Engineers held in October at San Francisco, W. P. Lass presented an elaborate paper on the new cyanide plant erected for the purpose of treating the pyritic concentrate recovered at the five mills of the Alaska Treadwell group of mines These mills crush in the aggregate about 5000 tons per day, and by means of Frue vanners about 90 tons of concentrate is obtained per day. The gold content of this product varies from 2½ to 4 oz. per ton. The average may be taken at rather over 3 oz. The gold contained in it represents 37% of the content of the original ore. Until recently this concentrate has been sold to the Tacoma smelter, and the companies were charged $11·95 for freight and treatment. In order to reduce this cost it was decided three years ago to experiment with fine-grinding and cyanidation. Accordingly a small plant was erected consisting of a tube-mill, amalgamating plates, Pachuca vat, and accessories. It was found that 75% of the gold content could be recovered by amalgamating the ore during and after reduction to *minus* 200, and that by amalgamation followed by cyaniding a total recovery of 96% could be effected. It was figured that with a plant capable of handling the whole product the cost would be $3·25 per ton, and this added to $2·48 representing the loss of 4% on a 3% gold content would bring the total cost to $5·73 per ton. Thus a saving of $6·22 would be obtained by substituting local treatment for shipment. Subsequently it was found that the same extraction could be obtained by cyaniding direct without amalgamation. However, it was

thought best when building the full plant to provide for both processes, but after five months run the amalgamation plates were discarded. The accompanying flow-sheet shows the plates in place. The concentrate is sluiced direct from the bins to Dorr classifiers, which feed their coarse product into Abbé tube-mills. These



Flow-Sheet of Treadwell Cyanide Plant.

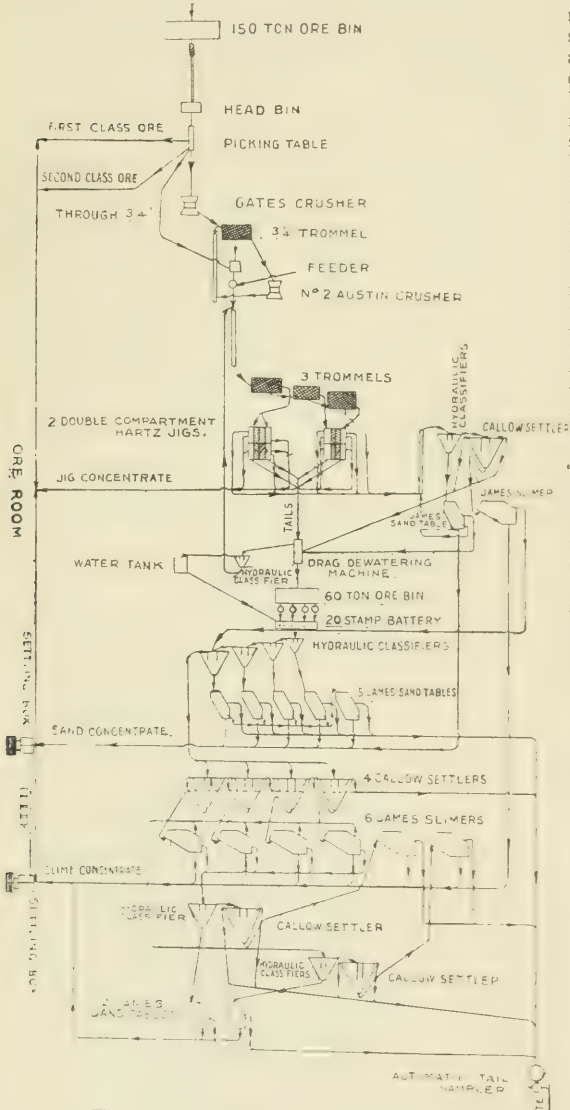
1. 75-H.P. Electric Hoist.
2. Osgood Track-Scales.
3. Car-Tipples.
4. Ore-Bins.
5. Dorr Classifiers.
6. Abbé Tube-Mills.
7. Classifiers.
8. Launder Distributors.
9. Amalgam-Plates for coarse pulp.
10. Air-Lifts
11. Dorr Classifier.
12. Abbé Tube Mill.
13. Air-Lift.
14. Tank.
15. Callow Tanks.
16. Launder Distributors.
17. Amalgam-Plates for fine pulp.
18. Distributor.
19. Callow Tanks.
20. Callow Tanks.
21. Pierce Amalgamators.
22. Preliminary Agitation-Tanks.
23. Aldrich Electric Triplex Pump.
24. Pachuca Agitation-Tanks.
25. Byron Jackson 4-in. Cent. Pumps.
26. Pulp-Tank.
27. Wash-Water Tank.
28. Air-Lifts.
29. Kelly Filter-Presses.
30. Distributor.
31. Clarifying-Tank.
32. Gold-Sumps.
33. Wash-Water Sumps.
34. Aldrich Electric Triplex Pump.
35. Merrill Zinc-Feeder.
36. Aldrich Electric Triplex Pump
37. Merrill Gold-Precipitation Presses.
38. Acid-Tanks.
39. Drying-Furnace for Precipitate.
40. Faber du Faur Furnaces.
41. Amalgam-Barrel.
42. Amalgam-Press.
43. Storage-Tanks for barren solution.
44. Air-Lift.
45. Air-Lift.

mills have corrugated sectional liners, and 3 in. Danish pebbles are used. When amalgamation is employed the overflow from the classifiers and the discharge from the tube-mills is passed over two sets of plates for treating the coarse and fine pulp respectively, in the way shown in the flow-sheet. The pulp from the amalgamators or, if these are omitted, direct from the tube-mill circuit goes to Callow cones, the spigot discharge from which is given a short preliminary cyanide treatment in 4 Pachuca vats. The main treatment is effected in 8 Pachuca vats, and is in two stages. In the first treatment, eight hours agitation is given with 0·1% solution, and it takes 18 hours for settlement and decantation. Afterward a second treatment is given with solution drawn from the wash-solution storage tanks, the cyanide strength being 0·075%. This agitation lasts for 2 hours, and the solution is then decanted and used as solution on a new charge of pulp in another vat, cyanide being added at the same time. The pulp after the second agitation goes to Kelly filter presses, and after extraction of the solution is given a wash. The gold solution goes to Merrill precipitation presses. It will be seen that the cyanide solution passes from the end to the beginning of the series of operations, in the opposite direction to the flow of ore. A two months run from May 16 to July 15 of this year, after amalgamation had been discarded, gave the following results as regards cost and extraction :

Content of concentrate	$55·49
Content of tailing	$1·89
Tons treated	4080
Extraction	96·6%
Cost per ton :	
Labour	$1·24
Power	$0·25
Pebbles (13½ lb.)	$0·18
Cyanide (2½ lb.)	$0·53
Zinc-dust (2·09 lb.)	$0·17
Other chemicals and supplies	$0·35
Total	$2 72

Electrolytic Assay of Gold Solutions.—At the September meeting of the Chemical, Metallurgical, and Mining Society of South Africa, Charles Crighton read a paper describing the electrolytic method of assaying gold solutions in use at the Kleinfontein mine. The apparatus consists of four oblong frames, measuring 2 ft. 10 in. by 3 ft. 6 in., connected in parallel and each holding eight beakers. Above and on one side run two copper rods connected with the batteries that are the source of current. The beakers each contain anodes and cathodes connected with these rods. The anodes consist of $\frac{5}{16}$ in. arc-lamp carbons and are held in position by clamps fitted to the copper bar above the beakers. The cathodes are made of assay lead-foil, folded into cylindrical shape, with serrations at the lower edge; these are connected by clamps and wires to the copper rod running along in front of the beakers. The current is supplied by three 2-volt accumulator cells, which being connected in series give a terminal pressure of 6 volts. The amount of current passing through the solution varies directly with the content of cyanide. For instance, a solution containing 0·3% cyanide passes 0·1 ampere, and a solution containing 0·02% cyanide will take 0·04 ampere. The time required for the complete deposition of the gold is 4 hours, after which the carbon anodes are removed, the current switched off, and the lead cathodes disconnected and removed. When dry, the cathodes are folded into small compass and cupelled with a small amount of silver. The whole time occupied in the process in 5 hours. Precaution

has to be taken that the carbon anodes are not left in the solution while no current is passing, otherwise some of the gold will be precipitated on the anode. If the solution should offer too great a resistance to the current it is well to add a small amount of cyanide so as to increase the amount of current passing and accelerate the deposition. This method has the advantage of requiring little personal attention, but where a great number of assays have to be made, the time occupied is against it, as compared with the usual precipitation method.



Flow-Sheet of Hudson Bay Concentrator.

Determining the Quality of Lime.—The *Bulletin* of the American Institute of Mining Engineers for November contains a paper by L. W. Bahney, describing a rapid method of estimating the amount of calcium oxide in commercial lime, such as is used in the cyanide process for maintaining protective alkalinity. The chemical constitution of the lime supplied for this purpose varies widely, according to the quality of the limestone used, the degree of efficiency of the calcining operation, and the conditions under which it is stored. The author's method requires standard solutions of oxalic acid and phenolphthalein. The acid solution is made by taking 14·6068 grammes of crystals and dissolving it in sufficient water to make a litre of solution, and the latter is made by dissolving $\frac{1}{2}$ gramme of phenolphthalein in 50 cc. alcohol and 50 cc. water. The sample is ground to pass 200 mesh; 50 cc. of water is placed in a 300-cc. Erlenmayer flask, and 650 milligrammes of the sample added. After vigorous shaking, 2 drops of phenolphthalein solution are added, and then the oxalic acid solution added until the pink colour is discharged. Another shaking is then given. When the colour returns it will be a bright vivid pink if due to lime, and the addition of perhaps 0·5 cc. of solution will be necessary to discharge this colour; but if the flask is again shaken and the colour is a faint, weak pink returning slowly, this is the end-point for the lime, and indicates that the magnesia is asserting itself. At all times during the addition of the oxalic acid solution the flask should be violently shaken, so that the calcium oxide shall pass into solution. In nearly every instance of titration of a high-grade lime, the pink colour remained vivid nearly to the finish, which shows that the calcium oxide is rapidly soluble. If a complete titration is allowed to stand for from 15 to 30 minutes the pink colour will return and show as brightly as in the beginning. The reading of the burette is in percentage of calcium oxide.

Concentration at Cobalt.—The *Canadian Mining Journal* for November 15 contains a description of the new crushing and concentrating plant erected by the Hudson Bay Mining Co. at the northern end of the Cobalt district. The veins are in conglomerate and contain niccolite, smaltite, and calcite, while the country rock for a foot on each side carries leaf silver. In the new mill, there are five products, namely, 1st and 2nd class hand-picked ore, and jig, sand, and slime concentrates. The capacity of the mill is over 2000 tons per month; the average assay of the mine ore is 44 oz. silver and of the tailing 3 to $3\frac{1}{2}$ oz. The ore from the mine after passing the picking table goes to crushers, whereby it is reduced to less than $\frac{3}{4}$ in. mesh, and then to three sizing screens, which separate it into four sizes, $+\frac{1}{2}$ in., $+\frac{1}{4}$ in., $+\frac{1}{16}$ in., and $-\frac{1}{16}$ in. The first three sizes are delivered to 4 Harz jigs of the double compartment type, two of them handling the $+\frac{1}{2}$ in. material. Any native silver is removed from the various concentrates before they go to the ore-room. The hutch products join the $-\frac{1}{16}$ in. size from the screens and are raised to a hydraulic classifier, which removes the sand. This sand is treated on a James table, and the concentrate therefrom piped to the ore-room. A middling is returned for re-treatment. The overflow from the hydraulic classifier passes to a Callow settler, and the slime is treated on a James slime-table. The tailing from the jigs and tables goes to a drag dewaterer, and then to the battery, which contains 20 stamps weighing 1250 lb. each, with a 16 mesh screen. The pulp from the stamps goes to hydraulic classifiers, the sand being treated on 4 James tables, the middling product of each being re-treated on a fifth table; and the slime thickened in Callow cones and treated on 4 James slime tables. The middling from the slime tables is classified and the two products treated on two other tables. The total extraction of silver by all these processes is 89%.

The Clancy Process.—In our issue of January last we gave a long abstract of a paper by J. C. Clancy de-

scribing his cyanide process, in which calcium cyanamide is used as the source of cyanide. In *Mining Science* for November 9, A. W. Warwick, chief metallurgist to the Moore Filter Co., which owns the process, describes the new plant erected at the Ajax mine, Cripple Creek, for the purpose of treating low-grade sulpho-telluride ores that have not so far been profitable. Mr. Warwick prefaces his article by saying that the plural is necessary for describing the ores of this mine, as there is a great variety of them, and it has proved advantageous to keep them apart when treating them by the Clancy process. Readers of our former article will know that in this process the solution contains calcium cyanamide, potassium cyanide, sulpho-cyanide, and iodide, and that the solution is electrolysed with the object of obtaining the nascent oxygen required for the reaction. The sulphocyanide and iodide are not lost, and the solution can be used over again, the necessary cyanide being obtained by the continual addition of cyanamide. During the experiments at the Ajax plant, the important discovery was made that much less electric current can be used than was at first supposed, and thus a cost that might have threatened the process has been removed. Here a current density of only 5 to 7 amperes per square foot of electrode is used, instead of 50 as originally figured. This makes a great difference, and during a 24 hours agitation the energy required will only be from one-tenth to one-seventh of a kilowatt per ton of ore, instead of 4½ kilowatts. The plant has a capacity of 200 tons per day. The ore is crushed in rolls and then reduced to 150 mesh in tube-mills, the solution being introduced in the latter. Subsequently the pulp is sent to agitators having a capacity of 80 to 100 tons dry, the ratio of ore to solution being 1 : 1½. In each agitator is 20 electrode-baskets, each having an anode surface of 4 sq. ft. and a capacity of 35 amperes. After agitation the pulp goes to Moore filters and the solution zinc-dust precipitation-boxes. The movement of the pulp is effected throughout by air-lift. The results obtained at this plant will be awaited with unusual interest.

CURRENT LITERATURE.

Prevention of Overwinding.—In the *Colliery Guardian* for November 3, Henry Briggs describes a new apparatus for preventing overwinding in mines, at work at the Dunnikier Colliery, Fifeshire, invented by the manager, J. M. Thomson.

Mine Air.—The *Journal of the Franklin Institute* for November contains a lengthy paper by E. M. Chance, chief chemist of the Philadelphia & Reading Coal & Iron Co., describing the methods of estimating gases in the air of coal mines and the symptoms caused by their inhalation.

Mine Accidents.—At the November meeting of the Manchester Geological and Mining Society, G. B. Harrison delivered a presidential address on accidents due to falls of ground in coal mines.

Timber used in Mining.—The *Canadian Mining Journal* for November 1 contains an article by H. R. MacMillan on forestry as applied to the use of timber for mining purposes in Canada.

Flotation.—In the *Engineering and Mining Journal* for November 18, D. P. Mitchell describes the Elmore and Minerals Separation plants at the works of the Zinc Corporation, Broken Hill.

Slime Filtration.—The *Bulletin* of the American Institute of Mining Engineers for November contains a paper by George J. Young detailing a great variety of experiments in connection with slime filtration.

Cost of Stamp-Mills.—The *Mining and Scientific Press* for October 28 contains an article on the cost of erecting and constructing a stamp-mill and its accessories.

Water in Mines.—In the *Engineering and Mining Journal* for November 18, Edmund R. Kirby describes his method of stopping the flow of water in mines by injecting mud, sawdust, or other obstructive matter other than cement into the crevices.

The Talisman Mine.—The *Proceedings* of the Australasian Institute of Mining Engineers for September contains a paper by Arthur Jarman describing the mine and metallurgical plant belonging to the Talisman Consolidated, in New Zealand.

Great Cobar.—Donald Clark commences a series of articles on the Great Cobar copper mine in New South Wales in the *Australian Mining Standard* for October 12

Tungsten and Molybdenum in Queens'and.—The *Queensland Government Mining Journal* for October publishes a preliminary report by Lionel C. Ball, assistant government geologist, on the occurrences of wolframite and molybdenite in Queensland.

Valuation of Oil Lands.—In the *Mining and Scientific Press* for November 4, William Forstner applies the principles laid down by M. H. Burnham in his articles 'The Finance of a Mine' to the valuation of oil lands.

Gas-Power at Waihi.—The *Proceedings* of the Australasian Institute of Mining Engineers contains a paper by S. E. Fraser on the gas-power plant at the Waikino mill, belonging to the Waihi Gold Mining Co.

Künzel's Gaseous Fuel. — *Mining Science* for November 2 contains an article on a gaseous fuel prepared from oil and suitable for steam-raising, smelting, etc., invented by C. A. Künzel and used at a smelter at Buena Vista, Colorado.

Power from Sunshine. – The *Engineer* for November 10 describes a plant invented by Frank Shuman, of Philadelphia, for producing power by boiling water by means of the sun's rays. This plant is to be erected in Egypt. We gave our opinions on the economies of concentrating the sun's heat in our issue of March 1910

British Aluminium Co.'s Hydro-electric Works.—At the meeting of the Institution of Civil Engineers held in November two papers were read on the hydro-electric plant of the British Aluminium Company at Kinlochleven, Scotland, by A. H. Roberts and F. B. Sonnenschein respectively.

Bolivian Railways.—The *Engineer* for November 3 contains an article by P. F. Martin describing the new railway from the Pacific to Bolivia, starting at Arica on the Chile coast and terminating at La Paz. It is expected that the railway will be completed early next year. The line is 267 miles long, the greatest altitude is 14,000 ft., and 28 miles is built on the Abt rack system where the gradient is 6%.

Prospecting in Brazil.—In the *Mining and Scientific Press* for November 4, Alexander P. Rogers describes the goldfields on the eastern side of the Andes to the north and east of La Paz and the methods of reaching them from the Amazon river.

Electrolytic Assay.—At the September meeting of the Chemical, Metallurgical, and Mining Society of South Africa, C. Crichton read a paper describing the electrolytic method of assaying auriferous cyanide solutions, in use at the Kleinfontein.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be supplied on application to The Mining Magazine.

BOOKS REVIEWED

A TEXT-BOOK OF THEODOLITE SURVEYING AND LEVELLING. Second Edition. By James Park. Cloth, octavo, 320 pages, illustrated. London: Charles Griffin & Co. Price 7s. 6d For sale by *The Mining Magazine*.

The author is one of the best known writers on subjects connected with engineering, geology, mining, and metallurgy. He has the gift of making abstruse problems seem quite simple, and we often regret that his activity is centred at so far distant a place as the University of Otago, New Zealand. His books on 'Mining Geology' and the 'Cyanide Process' are better known in this country than his treatise on 'Theodolite Surveying and Levelling.' We take the opportunity, therefore, of the issue of this second edition to draw attention to it. The headings of the various chapters are as follow: The Theodolite; Chains and Steel Bands; Obstacles to Alignment; Meridians and Bearings; The Theodolite Traverse; Coordinates of a Station; Calculation of Omitted or Connecting Line in a Traverse; Calculation of Areas; Subdivision of Land; Triangulation; Determination of True Meridian, Latitude, and Time; Levelling; Railway Curves; Mine Surveying. The second edition contains many additions and revisions. We consider that Chapter XII, relating to the determination of the true meridian, latitude, and time, and occupying nearly one-third of the book, is of great value to the mining engineer travelling or working in distant countries.

NOTES ON THE MINERAL DEPOSITS OF THE ANGLO-EGYPTIAN SUDAN. By Stanley C. Dunn. Pamphlet, 70 pages, with maps and illustrations. Khartoum: The Sudan Press; Edinburgh: Oliver & Boyd. Price 1s. 6d. For sale by *The Mining Magazine*.

This is the first of a series of Bulletins issued by the Sudan government, a scheme undertaken with the idea of making the resources of the Sudan better known. The first part of the pamphlet gives a general idea of the geology and of the gold, copper, lead, coal, iron, and other known deposits. Following this is a historical account of ancient gold mining operations. A third chapter gives extracts from Russegger's 'Travels in the Sudan.' Russegger was an Austrian bergrath who was sent in 1835 to the Sudan at the request of the Khedive for the purpose of trying to help the local exchequer by discovering gold mines. The remaining half of the book contains extracts from reports made during the last 10 years, by mining engineers, who have examined various tracts of the country for English prospecting and development syndicates. The book is one of distinct and permanent value to those in search for information about the Sudan.

THE LAY-OUT, DESIGN, AND CONSTRUCTION OF CHEMICAL AND METALLURGICAL PLANTS By Oscar Nagel. Cloth, octavo, 206 pages, illustrated. New York: The Author. Price 8s. 6d. For sale by *The Mining Magazine*.

This book gives an outline of the plant required in connection with a number of industries, such as stamp-milling, cyaniding, silver refining, spelter and copper manufacture, cement, brick, gas, coke, acid, and alkali works, etc. The author takes one example of each type of plant. Practically all the matter has already appeared in print, either in technical papers or in manufacturers' circulars. The book may be acceptable to people wanting a general idea of the plant and buildings required for various commercial processes, but it seems to us far too casual and sketchy to be of any great technical value.

THE WORLD'S MINERALS. By Leonard J. Spencer. Cloth octavo, 220 pages, with coloured plates and other illustrations. London: W. & R. Chambers. Price 5s. For sale by *The Mining Magazine*.

It is a real pleasure to read this book and to write a review of it. Many elementary books are written either by semi-quacks or by eminent scientists who are so steeped in learning as to be out of touch with the requirements of the beginner, and they therefore do not fulfil their object, being either unreliable or involved. The really illuminating and readable elementary books are few and far between. By 'elementary' we do not mean 'rudimentary,' but 'explanatory from first principles yet containing sufficient information to satisfy a trained intellect.' Mr. Spencer's book exactly meets this definition and should have a hearty reception from those who wish to obtain a general idea of the common or typical minerals and of the main principles of mineralogy. The author is one of the staff of the British Museum, and is editor of the *Mineralogical Magazine*, so he is qualified by both scientific and literary experience. In addition he gave us an English translation of Bauer's great work on precious stones, now unfortunately out of print. We have said that the present book gives a clear outline of the chief minerals, but of course it cannot teach everything, for without the minerals themselves, no education can be complete. His 40 coloured plates are really excellent, aud it is marvellous how they can be executed at the price charged for the book. The descriptions of the crystal systems and the method of making models out of cardboard are clear and helpful. Following this section are classifications of minerals according to colour, weight, and composition. The author's classification in connection with the last named follows that of the British Museum, namely, the grouping according to combination with oxygen, sulphur, silica, carbonic acid, the halogens, etc. But he also has a secondary classification according as to whether the minerals are ores, precious stones, constituents of rocks, abrasives, spars, etc. Then follow descriptions of 116 typical simple minerals. The book is brightly written and is not devoid of humour; the author quotes the advertisement of the American dealer in mineral specimens: "Minerals for presents; send your friend an apatite for his Christmas dinner." In conclusion we may say that the book is one that we shall always recommend to those in search of the practical and the beautiful. E.W.

MINES OF AFRICA. By R. R. Mabson. Cloth octavo, 900 pages, with many maps and plans. London: *The Statist*. Price 21s. For sale by *The Mining Magazine*.

This excellent handbook now appears every year. Like many other books of its sort, it has expanded in bulk, contents, and value with each edition, and it now includes notices of the mines of West Africa and Rhodesia as well as those of the Transvaal. The present edition includes a large amount of new material gathered during Mr. Mabson's visit to South Africa during the early part of this year. The book gives details of all the mining companies working in Africa, somewhat after the manner of Skinner, but it deals in addition with the technical practice, cost, production, etc., which make it much more interesting. The plans and sections of various mines, and also the general and local maps are useful. We have no wish to be hypercritical, but we consider it would be advantageous to separate the Rand, other Transvaal, Rhodesian, and West African mines into groups, instead of mixing them in one alphabetical list.

COMPANY REPORTS

British Broken Hill.—It is pleasant to be able to record that a great change of fortune has come to this mine. In our June issue, when reviewing the progress during the second half of 1910, we stated that the company had not been one of the most successful on the Barrier Range, and that on several occasions the mine had to be closed during periods of low prices. From December 1907 to June 1910 the mine was idle, but during that time, much money was spent in remodelling the lead concentrator and in providing an Elmore zinc plant, so as to enable the company to treat the ore at lower cost, and obtain a better extraction. The mine was reopened in June 1910, and the new plant was gradually brought to a state of efficiency. The great turn in the fortunes of the company, however, came with the discovery, in June last, of a new lode at the south end of Block 16. Our Melbourne correspondent has already recorded the details in connection with the development of this new lode. The manager, W. H. Woodhead, announced at the end of October that the ore reserve had thereby been increased by two million tons. The report of the directors now issued covers the half-year ended June 30. During that period, 63,370 tons of ore went to the lead concentration plant, averaging 13·6% lead, 12·8% zinc, and 7·6 oz. silver, and 9657 tons of lead concentrate was produced, averaging 63·4% lead, 7% zinc, and 26 oz. silver. In addition, 34,845 tons of zinc tailing, averaging 15·3% zinc, 3·9% lead, and 3·9 oz. silver, was produced and sent to the Elmore plant, which produced 9621 tons of zinc concentrate, averaging 43% zinc, 10% lead, and 12 oz. silver. The income from the sale of lead concentrate was £68,250 and of zinc concentrate £22,739. Other credit items brought the revenue to £98,065, of which £15,142 was net profit. Adding the balance from the previous half-year, the amount available for distribution was £33,943. Out of this £26,400 has been distributed as dividend, being at the rate of 10% on 240,000 ordinary shares of £1 each and 25% on 60,000 privilege shares of 8s. each. Owing to the increase in ore reserves consequent on the discovery of the new lode, it has been possible, since the close of the half-year under review, to work three shifts per day at the concentrator, and to increase the monthly output from 11,000 to 18,000 tons. In addition to the zinc tailing, there is a large amount of slime that cannot be efficiently concentrated by the Elmore process, so a contract has been made for the sale of the accumulated and current slime at 8s. 6d. per ton.

Great Fitzroy.—This company was formed in the summer of 1908 to acquire a copper-gold mine near Rockhampton, Queensland. Bewick, Moreing & Co. are general managers, and the control is indicated by the names on the list of directors, Philip Charley, H. C. Hoover, G. P. Doolette, W. J. Loring, W. S. Robinson, and J. L. Wharton. The results obtained have so far been disappointing, for in the first place water concentration was a failure, and secondly the flotation plant has not yet been satisfactorily adapted to the nature of the ore. The report now issued covers the year ended June 30. During that period, 69,791 tons of ore was extracted, and 59,128 tons, averaging 3½% copper and 3 dwt. gold, was sent direct to the smelter, while 10,470 tons averaging 2·4% copper and 1·7 dwt. gold was treated in the Minerals Separation flotation plant. This plant was in operation for 4 months, during which time the recovery was 81½% of the copper and 47½% of the gold. With the low current price of copper and the poor extraction of the gold, the concentration was not a success, so the work was suspended and experiments started with a view to increase the efficiency. Since the end of the company's financial year, operations have been re-started, the scheme being to make a smelting mixture of concentrate obtained from the silicious ore and of selected pyritic ore. During the year under review, 782 tons of matte and 1268 tons of blister copper were despatched to the Port Kembla refinery, the matte being shipped during the earlier part before the converter plant was at work. The revenue from the sale of the metals produced was £137,287, and the working expenses £138,464. Debenture interest and general expenses brought the loss to £9836. In addition, it has been necessary to write off for depreciation of plant and for development, and these amounts together with the debit balance brought in from the previous year, make the adverse balance £57,700. A year ago we recorded that £100,000 of debentures had been created for the purpose of providing working capital. These have all been issued, and in addition £20,000 has been borrowed from the Australian Metal Co. The general managers mention that they have had to decrease the estimate for ore reserve, because the flatness of the pyritic lode involves the leaving of a large proportion of the ore as pillars. The figures at June 30 were: pyritic ore, 49,934 tons averaging 2⅛% copper and 2⅛ dwt. gold; silicious ore, 540,588 tons averaging 3% copper and 2½ dwt. gold.

Gwalia Consolidated.—This company was originally formed in 1898 to acquire the Star of Gwalia, adjoining the Sons of Gwalia, in Western Australia, but as the mine was unsuccessful the Violet at Lake Way was bought in 1902, and the adjoining Lake Way mine in 1906. As recorded in our issue of February last, the ore at the Violet has proved refractory and much of it is of low grade. The managers, Bewick, Moreing & Co., and the consulting engineers, Hooper, Speak & Co., have been engaged for some time in studying possible processes of treatment, so far without result. The report now published covers the year ended June 30, and shows that the mill was closed at the end of July 1910, and the mine in October. The accounts show a deficiency on the year of £10,712. At the meeting of shareholders held last month, Edward Hooper, the chairman, gave further particulars relating to the difficulty of treating the ore. He stated that roasting and cyaniding would be the correct process, but the price of fuel for roasting is prohibitive. An alternative proposition involving a shorter roast has also been considered, but its adoption would involve the provision of dry-crushing machines and pan-amalgamators, and the directors are not inclined to recommend so large a capital expenditure. Many other processes have also been tried without success. Flotation gives no results. At the present time, the engineers are examining a method of treatment proposed by A. L. Simon.

Mount Lyell.—The report of this copper mine in Tasmania for the half-year ended September 30 shows that 100,957 tons of ore was raised from the Mount Lyell mine and 59,738 tons from the North Lyell, a total of 160,965 tons, averaging 2·7% copper, 1·56 oz. silver, and 0·54 dwt. gold. On smelting, this gave 3841 tons of blister copper, containing 3797 tons copper, 246,099 oz. silver, and 5018 oz. gold. The produce was 271 tons of blister copper less than during the previous half-year, owing partly to shortness of labour interfering with mining operations, and partly to some of the stopes yielding poorer ore. Of the copper produced during the period, 2532 tons was sold at an average price of £57. 2s. 3d. leaving 1265

tons unsold; the balance, 1196 tons, brought forward from the previous half-year, was sold at an average price of £57. 16s. 10d. The cost of producing blister copper was 20s. 0½d. per ton of ore, being an increase of 2s. 4½d. over the cost during the previous half-year, the rise being due to the smaller tonnage, the greater amount of underground stoping, and the higher cost of coke. The last-named disadvantage has since been removed by the starting of the coke-ovens at Port Kembla. The reserves on September were: At Mount Lyell open-cut, 360,975 tons averaging 0·6% copper, 1·93 oz. silver, and 0·86 dwt. gold, and underground, 2,135,333 tons averaging 0·52% copper, 1·97 oz. silver, and 0·5 dwt. gold; at North Lyell 1,023,362 tons averaging 6% copper, 1·33 oz. silver, and 0·1 dwt. gold. At the North Lyell the developments reveal a continuance of the orebody in depth. The profit for the half-year was £69,033, after payment of taxes, £5098, allowance for depreciation £9468, and allocating £10,392 to the exploration and development fund. Owing to the strike, and the consequent closing of the mine, since the end of the half-year, the directors have decided to pass the dividend.

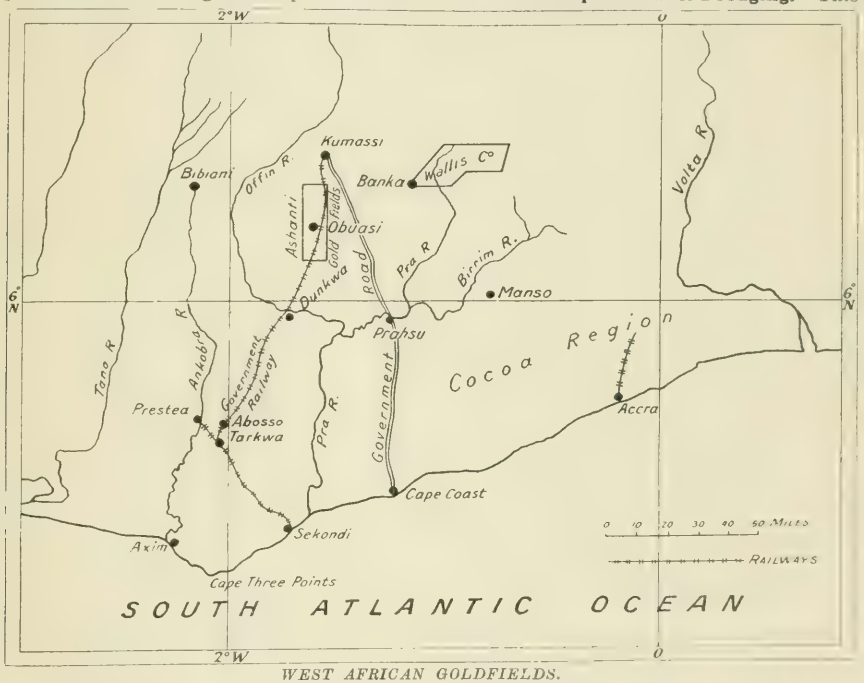
Lena Goldfields.—The properties operated by this company are situated in the valleys adjoining the Victim river, a tributary of the Lena, in eastern Siberia, and consist of remarkably rich gold gravel deposits. They are worked through the local Russian company, the Lenskoie, 70% of the shares in which are owned by the English company. The report now issued covers the year ended September 30. C. M. Rolker reports that, from October 1910 to October 1911, the production of gold was 430,818 oz. worth £1,619,331, and that the average content per cubic yard was 10¾ dwt. The costs of mining for the same year have not yet been determined, but the costs during the previous year were £901,008 or 25s. per cubic yard. The profit and loss account of the English company showed that the receipts from dividends on Lenskoie shares for the year 1909–10 were £313,077, and that the interest on money lent was £28,716. The profit was £333,643, and £336,664 has been distributed as dividend, being at the rate of 30%. The company has also made a profit of £519,915 by the sale of shares in the Lenskoie company that cost originally £68,820. This amount has been put to reserve, and thus the position of the company has been immensely strengthened, without any great reduction in the holding in Lenskoie shares. As regards the future, the reserve of gravel is estimated to be sufficient for 3½ years' work, and the drilling operations indicate that this figure will be substantially extended.

Oriental Consolidated.—This is an American company, formed in 1897 to acquire a gold-mining concession in northwestern Korea, or Cho-sen, as it is nowadays called. H. C. Perkins is president, and the Ogden-Mills and Haggin groups have large holdings. The principal mines are the Tabowie and Taracol, and there are also the Chintui, Kuk San Dong, Charabowie, and Candlestick. Five mills have been erected, containing in all 240 stamps, together with concentrators and cyanide plants. The report for the year ended June 30 shows that 342,956 tons of ore was mined (121,257 coming from the Tabowie, and 85,062 from the Taracol), and that the yield was $1,776,470 or $5·17 per ton. The total expense was $868,626, leaving a profit of $672,720 or $1·96 per ton. The dividends absorbed $644,085. This company is the pioneer in Korea and the methods of mining and extraction are of the most up-to-date character. The recovery was 90½%. The developments during the year have been satisfactory on the whole. The Chintui and Kuk San Dong mines are approaching exhaustion. At the Tabowie the lode is narrower on the 9th level than it is above, and the content is not much greater. The total ore reserves were estimated on June 30 at 802,280 tons, with an average content of $4·80. Alfred Welhaven is manager, and A. E. Drucker is metallurgist.

Ouro Preto Gold Mines of Brazil.—This company was formed in 1884 to acquire the Passagem mine in the State of Minas Geraes, Brazil. John Taylor & Sons are the managers, and A. J. Bensusan is superintendent. The lode has a flat dip, so much so that the men can walk down the three shafts, which commence near each other at the surface, and become farther apart with depth. A new vertical shaft is now being sunk to meet the No. 3 shaft at a point a little lower than the 680 metre level. It will be remembered that in our issue of November 1910 we gave a summary of papers read by Mr. Bensusan and by R. H. Kendall on the mining and metallurgical practice at this mine before the Institution of Mining and Metallurgy. During the year ended June 30, 69,680 tons of ore was mined and milled, yielding gold worth £99,143, being at the rate of 28s. 5d. per ton. These figures compare with 75,612 tons, £108,773, and 28s. 9d. a year ago. The fall in the tonnage was due to a temporary scarcity of workmen. The working expenses, including royalty, were £88,581, other income was £1643, and the working profit was £12,205. Out of this £5598 has been written off for depreciation, £3663 has been paid as preference dividend at the rate of 10%, and £2500 on the ordinary shares at the rate of 2½%. The mine continues to develop satisfactorily. On June 30 the reserve was 170,834 tons, practically the same figure as a year ago. In addition, there are large bodies of ore not sufficiently developed to warrant an estimate. In last year's report it was mentioned that the adjoining Santa Anna and Macquiné properties had been let on option. The option has now been acquired by the Brazilian Mining Syndicate, which, under the guidance of John Taylor & Sons, is sinking a shaft and driving a crosscut at the first-named in order to explore the deposit.

Cape Copper.—This company was formed in 1863 to work the Ookiep copper mine in Namaqualand, Cape Colony. John Taylor & Sons are the managers. The high-grade ore is shipped to Britonferry, South Wales, for treatment, as is also the matte produced from the lower grade ore that comes from neighbouring properties. For some time the mine has been nearing exhaustion, but it still continues to yield a limited amount of ore. The Nababeep mine yields lower grade ore and continues to develop satisfactorily. Ore also comes from several trial mines. The company has an interest in the Tilt Cove mines, Newfoundland, and treats the ore at Britonferry. Options are held on properties in Alaska and India. The report for the year ended August 30 shows a considerable diminution in the profits as compared with the previous year, the figure being £60,862 as compared with £124,659, the reduction being due chiefly to the lower content of the Ookiep ore. During the year 15,978 tons of ore was raised from the Ookiep mine averaging 12% copper, as compared with 15,196 tons averaging 14·5% the year before. At the Nababeep group 60,005 tons averaging 5½% was raised, and smaller amounts from other mines. Prospecting by bore-holes has been adopted at the various mines. The dividends distributed amounted to £37,500 on the ordinary shares and £5625 on the preference shares, being at the rate of 6¼% in each case. The total dividends to date have been £4,499,275. In May last, J. L. Dean, who had been superintendent at the Cape for 25 years, resigned; his place is temporarily held by Ernest R. Woakes.

Tolima.—This company was originally formed in 1871 to acquire the Frias silver-lead mine in Tolima, Colombia, and used to make excellent profits, but it had to be reconstructed in 1903 and 1909 with the object of providing further funds. The report now issued, covering the year ended June 30, shows that the mine has once more been placed on a profitable basis. Ore has been mined on various levels from 1100 ft. to 1600 ft., the total amount raised to the surface being 15,292 tons. After the removal of about half of this as waste, 7763 tons went to the mill, where 1295 tons of shipping concentrate was produced, assaying 472 oz. silver per ton. The amount receivable for this, after allowing for smelter's charges, was £60,452. The mining profit was £15,561. After payment of debenture interest and London administration expenses, and allowing for depreciation of plant, the net profit was £10,966, which, with £1678 brought forward, made a disposable balance of £12,644. Out of this, £3000 has been spent on additional water rights, £5500 has been devoted to the redemption of debentures, and £2500 has been distributed as dividend, being at the rate of 2½%. The outstanding debentures amount to £9994. The report states that the lode at the deepest level, 1620 ft., is developing in an encouraging way, and the future of the mine appears to be satisfactory. Arthur J. Russell is managing director, and John Russell superintendent.



WEST AFRICAN GOLDFIELDS.

Bibiani.—This gold mine is situated in West Africa to the northwest of Prestea and Taquah, and owing to its distance from water or railway communication its development has been hindered. It was introduced in London in 1899, and the company was twice reconstructed, the last time in 1908. Hooper, Speak & Co. are the consulting engineers, and R. J. D. Richardson is manager. The report now issued covers the year 1910. During this period 67,565 long tons of ore was raised and treated, and the yield by amalgamation and cyanide was worth £90,557, or 26s. 9d. per ton. These figures compare with 57,576 long tons, £98,669, and 34s. 3d. during the preceding year. The cost, according to the working account, was £73,173 or 21s. 7d. per ton, so that the working profit was £17,384 or 5s. 1d. per ton. The monthly statistics show wide variations in yield, cost, and profit. In the profit and loss account, there are items for depreciation £6626, debenture interest £4873, London charges £2416, and a number of other items, which bring the working profit down to a net profit of £2052. The ore reserve has been increased in value, but not in tonnage during the year. The figures on December 31, 1910, were 397,759 tons averaging 9·11 dwt., as compared with 417,978 tons averaging 8·58 dwt. At the meeting of shareholders held last month, it was announced that the slime plant was completed and had started working.

Ancobra Exploration & Dredging.—This company was formed in July 1909 to acquire from the Taquah Mining & Exploration Co. and the African Gold Dredging & Mining Concession certain plant and dredging rights in West Africa, including the dredging rights on the Ancobra river from Prestea to the sea, a distance of 70 miles. The control is with the Oceana Consolidated, and the management is with its subsidiary, the West African Trust. About a year ago, the services of S. J. Weis, a California dredging engineer, were secured. The report now issued covers the year ended June 30, and shows that the four dredges working on the river recovered 5120 oz. gold worth £21,747, of which £2025 was profit. After close study of the conditions and former operations, Mr. Weis is of opinion that it will be more profitable to work the gravel that forms part of the old river bed, instead of dredging the present course. In order to obtain full information as to the value of this gravel, he has engaged a drilling expert, who has had much experience in California, to thoroughly test the flats. If the results are in accordance with expectations, a new dredge is to be built at a cost of £20,000, and

the necessary funds will be provided by the issue of additional shares. At the meeting of shareholders, the chairman announced that, since the close of the company's financial year, one of the dredges has been working in exceptionally rich ground.

Sheba Gold.—This company was formed in 1884 for the purpose of acquiring a group of gold-mining properties in the Barberton district of the Transvaal. Dividends were paid from 1891 to 1898, but then came a series of disappointing years, and it is only during the past year that divisible profits have once more been made. The control is with Lewis & Marks, G. C. Fox is consulting engineer, and H. B. White has recently succeeded Howard Hill in the management. The report now issued covers the year ended June 30. During this period 49,455 tons of ore was raised, chiefly from the Zwarzkopje mine, and 24,016 oz. of gold extracted by amalgamation and cyaniding. This result was a great improvement over the previous year, when 40,750 tons yielded 14,120 oz. The revenue from the sale of gold was £95,903, and other credit items brought the total income to £99,471. The net profit was £20,573, out of which £13,486 has been paid as dividend, being at the rate of 5%. Since the close of the financial year, the profits have continued to be so satisfactory as to warrant the distribution of another 5%. The ore reserves have been substantially increased during the year, and stood at 104,250 tons on June 30, as compared with 24,000 tons a year before, and the grade is estimated to be equal to, if not greater than, that of the ore treated during the year. At the beginning of June it was decided to reduce the capital of the company by changing the denomination of the shares from £1 to 5s., and the capital now stands at £269,738 instead of £1,078,954 as formerly. An electric installation has been provided, and the battery is being driven by motor instead of by steam. The prospects of the company have vastly improved since we wrote our précis of the directors' report a year ago.

Nourse Mines.—This company was formed in 1894 as the Nourse Deep for the purpose of acquiring the deep levels of the Henry Nourse mine in the central part of the Rand. In 1905 the Henry Nourse property was absorbed and the name changed. The control is with the Wernher-Beit-Eckstein group and it is directed by the Rand Mines Co. R. A. Barry is manager in succession to Percy Cazalet, and B. Madew has recently been appointed consulting engineer in succession to G. E. Webber. The report for the year ended July 31 shows that operations are not conducted without difficulties, and that the recent expansion of metallurgical plant and development operations have not so far given the increased profit that was expected. The full plant of 260 stamps and 7 tube-mills came into operation early in the financial year, so that it was possible to treat 643,675 tons, or 179,098 tons more than during the previous year. The average grade of the mill-ore was 7·3 dwt. The recovery was 163,527 oz. by amalgamation and 60,044 oz. by cyanide, a total of 223,571 oz. worth £936,597, or 6·95 dwt., equal to 29s. 1d., per ton milled. The total working cost was £695,572 or 21s. 7d. per ton, leaving a profit of £241,024 or 7s. 6d. per ton. As compared with last year, the total profit was £49,520 greater, but the profit per ton fell by 9d. This reduction was due to a decrease in the grade of the mine ore by ½ dwt., but on the other hand closer sorting and higher percentage of recovery made the recovery in the mill only ⅕ dwt. less. The working cost shows a reduction of only 2d. per ton, which is naturally a disappointment. The failure to effect a greater reduction is due to a combination of causes, the chief of which is the scattered nature of the mine workings and the high cost of labour. An increased amount of development work has been done during the year, the footage being 28,549 or 10,793 more than the year before; the tonnage developed thereby was 750,198 tons, of which 614,171 tons was estimated to contain 7·6 dwt. gold. On the other hand it has been necessary to write down the ore reserve by raising the minimum content from 4·5 to 4·7 dwt., so the reserve on July 31 stood at 2,050,705 tons averaging 6·6 dwt., a reduction of 91,342 tons and an increase in average content of $\frac{1}{10}$ dwt. Nearly 1¼ million tons of ore is also in the mine averaging 3⅓ dwt. that is of no value at present. The circumstances in connection with power are adverse, for the electrification is only partly completed, and both steam and electric plants are at work. The prospects of the company are reported as fair; it is necessary that the full scale of operations be maintained, and that working costs be reduced by a concentration of underground operations. Of the profit made during the year, £64,455 was allocated to capital expenditure, £20,705 went as taxes, and £165,564 was distributed as dividend, being at the rate of 20%.

Giant Mines.—This company was formed in 1903 to acquire from the Enterprise Co. the Giant gold mining property situated 65 miles west of Salisbury, Rhodesia. The control is with the Weil group, and the staff of the Consolidated Gold Fields of South Africa are the consulting engineers, H. A. Piper being at the head. Dividends have been paid regularly since 1906, the ore reserve has been steadily increasing, and additions have been made to the treatment plant, until, 18 months ago, it contained 30 stamps and 2 tube-mills. The report now issued covers the year ended June 30 last. During this period, 123,789 tons of ore was treated, yielding 47,750 oz. gold worth £202,196, as compared with 65,953 tons, 24,089 oz., and £102,067 the year before. The percentage of recovery was 85%. The extraction per ton was 32s. 8d. as compared with 30s. 11d., and the cost at the mine was 13s. 9d. as compared with 17s. 6d. The working profit was £116,884 as compared with £44,316. After London expenses, taxes, and depreciation had been allowed, the net profit was £97,860. Out of this £33,080 has been placed to reserve and £49,360 distributed as dividend, being at the rate of 20%. The ore reserve on June 30 was 308,146 tons averaging 41s. 6d., as compared with 307,821 tons averaging 38s. 3d. the year before. Mr. Piper reports that the exploratory work, under the direction and advice of G. S. Corstorphine, undertaken with the object of recovering the faulted lode, has not yet given any positive results, but he has hopes that success will be won eventually.

Cam & Motor.—This company was formed in September 1910 by the London & Rhodesian Mining & Land Co., which is in the control of Julius Weil & Co., for the purpose of acquiring the Cam & Motor gold mines, situated in the Gatooma district of Rhodesia. Since then the Good Shepherd mine immediately adjoining the Cam mine has been acquired for 17,500 shares, and the issued capital increased to £467,500. At the flotation, £200,000 was provided as cash working capital. The geological formation consists of crystalline schists traversed by dikes of various characters. The ore is found in connection with silicious impregnations of the rocks and dikes, and arsenic and antimony are associated with it. At the time of flotation the ore reserve was figured at 302,000 tons averaging 45s. 6d. The report now issued covers the period from the time of registration of the company to June 30 last. Work has so far been confined to the development of the

Motor mine, and to the study of the methods suitable for the beneficiation of the ore. The latest cable advice, as recorded in the report, showed that the ore reserve had been increased to 700,000 tons estimated to contain an average of 47s. 2d. per ton. As regards treatment, it has been decided to adopt a system of roasting and all-sliming, and a plant with a capacity of 600 tons per month is being erected; the process consists of dry-crushing in a ball-mill, roasting in an Edwards furnace, and sliming in cyanide solution in a wheeler pan. If this experimental plant is successful, it will be expanded to a capacity of 500 tons daily. The laboratory tests indicate a recovery of 85%.

Messina.—This company was formed in 1905 to acquire a copper mine in the Northern Transvaal not far from the Rhodesian border. A. M. Grenfell is chairman, J. M. Calderwood is consulting engineer, and

J. Allen Woodburn is manager. Though the deposit is rich, progress has been hampered by the want of communication, and the consequent high charges for shipping ore and concentrate to England. The policy has been to confine the treatment in the mill to ore raised during development. The disadvantage as regards transport will be removed before long, on the completion of the two lines of railway connecting Pretoria and Delagoa Bay respectively with the Rhodesian railway system. The Pretoria railway has been completed as far as Bandolier Kop, which is 93 miles from Messina. An agreement has been made with the Government for the construction of a line from Tzaneen on the Selati railway to Bandolier Kop, thus affording access to Delagoa Bay, the nearest port. During the year ended June 30 last, 17,286 tons of ore was raised averaging 11% copper, and 2503 tons of concentrate averaging 50·8% produced. The amount of concentrate shipped was 2601 tons, and the cost of freight was over £14,000, while the sum realized was £57,049. The balance of working profit was £2061, but interest on debentures and insurance premium for redemption of debentures brought the balance on the wrong side to the extent of £5543. In order to continue development on an increased scale and to build additional concentration plant, an issue of £250,000 debentures has been made since the completion of the year under review. The capital of the company now consists of £165,451 in shares and £304,210 debentures. The ore reserves blocked out on June 30 amounted to 102,000 tons averaging 10%, and the probable ore to 328,000 tons, in addition to which there is a large amount of possible reserves. The assay value is calculated over a width of 5 ft. The minerals are chalcocite, bornite, and chalcopyrite, and no indication has yet been observed of any change in the nature of the deposit with depth. The new shaft has been completed to 818 ft., and development is being prosecuted in the ground thus made available. The directors announce an important find of coal 15 miles southwest of the mine, and the company has secured an option on the property. A test of the coal at the mine plant gave satisfactory results.

Simmer & Jack.—This is the leading mine of the Consolidated Gold Fields group on the Rand. The report now issued covers the year ended June 30 and shows that 890,200 tons of ore was hoisted and, after the removal of waste, 811,448 tons was sent to the mill. These figures are slightly lower than during the previous year, owing to trouble in connection with the scarcity of labour. By amalgamation in the battery 37,669 oz. of gold was recovered; during the first part of the period 300 stamps were running, and after the repairs to the battery were completed in February the full 320 were in operation. Below the 6 tube-mills 105,887 oz. of gold was recovered, while the cyanide plant yielded 75,734 oz. from the sand and 29,949 oz.

from the slime. The total yield of gold was 249,239 oz. worth £1,046,240, being at the rate of 6·2 dwt. or 26s. per ton milled. The working expenses were £501,414 or 12s. 5d. per ton, and the profit £550,187 or 13s. 8d. per ton. After the payment of taxes and allowances for depreciation, the balance was £526,866, while £168,519 was brought forward from the previous year. The dividend absorbed £600,000, being at the rate of 20%. The ore reserve on June 30 was estimated at 2,520,000 milling tons averaging 6·4 dwt. per ton, and there was also 470,000 tons of partly developed ore estimated to contain 5·7 dwt. The ore developed during the year has been of rather higher quality, but the amount is less, as, a year ago, the proved reserve was 2,690,000 tons. The reports by C. D. Leslie, consulting engineer, and A. W. Stockett, manager, show that all amalgamating plates have been removed from the stamps, a seventh tube-mill has been added, and three stationary amalgamating plates provided below each tube-mill.

Vogelstruis Estates.—This company was formed in 1893 to acquire, from the debenture holders of the Vogelstruis Gold Mining Co., an outcrop mine on the Rand, seven miles west of Johannesburg. A mill containing 80 stamps started in 1896, but did not run for long, as it was found necessary to do more development. Operations were resumed in 1903. Small dividends were paid in 1907–8–9. The control is in London, and H. Ross Skinner is consulting engineer. The report now issued covers the year ended June 30, and shows that the company is in an anxious position. It was difficult for a small mine with an isolated control to secure labour at a reasonable rate, and it was therefore found necessary to curtail development. By depleting the ore reserve, an average of 60 of the 80 stamps were kept at work, and the ore crushed amounted to 101,033 tons yielding gold £132,669. The mining account shows a loss of £999, and allowing £8655 for depreciation, and charging development cost on the ore reserve sent to the mill, the total debit for the year was £18,074. There are £94,100 debentures outstanding, and it has been necessary to suspend the annual drawings for their redemption. The ore reserve on June 30 was 147,815 tons, or 75,684 tons less than the year before. Development work has been entirely suspended, and ore is being mined wherever possible. This policy will be continued as long as debenture interest and administration expenses can be met

Jumpers.—This is one of the original outcrop mines of the central Rand and has escaped absorption. The ground should have belonged to the Geldenhuis, but owing to inaccurate surveys, other people obtained possession. During recent years, the control has been with the Wernher-Beit-Eckstein group. The mine is nearing exhaustion as also is its immediate neighbour in the east, the Treasury mine. An agreement was made in October last to work the two mines conjointly, so that the pillars left at the boundary between the two mines might be made available for extraction. The report now issued covers the year ended July 31 last. For the first three months the operations were confined to the Jumpers only; from November 1, 1910, to July 31, the results relate to the conjoint working. The amount of ore raised from the Jumpers was 87,365 tons and from the Treasury 48,353 tons, a total of 135,718 tons. The actual amount mined was 188,399 tons, the difference being due to careful sorting underground. The ore raised was further sorted on the surface, and 120,802 tons sent to the mill. Thus the proportion rejected was 36%. An average of 95 stamps were at work. The extraction by amalgamation was 33,402 oz., and by cyaniding 20,127 oz. a total of 53,529 oz. or 8·86 dwt. per ton milled. The income was £224,045 or 37s. 1d. per ton milled and the working cost £180,180. or 29s. 10d. In addition, 3203 oz. was recovered from accumulated slime, and 737 oz. from the treatment of dump ore. It has been possible to distribute £40,000 as dividend. The output during the past year was not so great as was expected, and the remaining life of the properties will be short. The reserve is estimated at 122,314 tons of profitable ore, and 108,000 tons of probable ore, the value of which is not exactly ascertained.

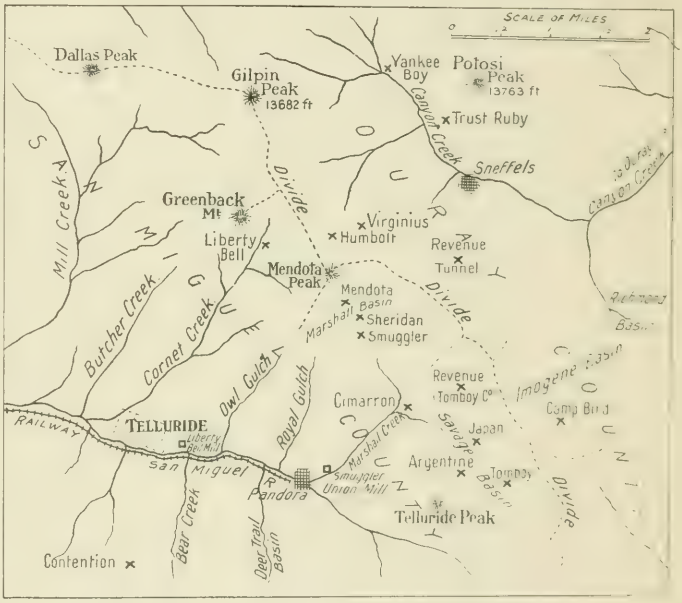
Famatina Development.—This company was formed in 1903 to acquire a copper mine in the Argentine Republic, 14,000 ft. above the sea in the Andes. Progress has been slow owing to a great variety of causes, as detailed in our issue of November last year. The report for the year 1910 shows that the conditions and circumstances have still been unfavourable. The smelter was idle from the early part of the year until October, owing to the failure of the Government aerial ropeway; during this time a second furnace, a briquetting plant, and a roaster were erected, and development was continued at the mine. While the smelter was at work, 11,237 tons of ore was treated yielding 1383 tons of copper matte and 4½ tons of blister copper, estimated to contain 392½ tons copper, 3976 oz. gold, and 72,221 oz. silver. The value of the recovered metals was £37,512, but the total expenses of mining, treatment, and administration were £82,221, so that the debit balance was £44,709. During the current year the smelting has proceeded with fewer interruptions, and from January to the end of October 933 tons of copper matte and 568 tons of blister copper were produced. Since April the whole of the output has been in the form of blister copper. There have been serious losses in copper and the precious metals owing to the escape of dust and fume, and flues and settling chambers are to be provided. The publication of the report has been delayed because the board desired that one of their number, R. F. Bury, should be present at the meeting of shareholders and give the latest news; but he has not been able to return from the mine before the end of the current year. It is intended to hold an adjourned meeting of shareholders early in the coming year, when Mr. Bury will present his report. It is stated that his mission has been successful, as he has been able to arrange with the Government for more settled transport facilities and for substantial reductions in the freight rates.

Great Cobar.—The report of this New South Wales copper mine covers the eighteen months ended June 30. During this time two breaks of a month each were made, one due to the coal strike, and the other to repairs in the main shaft. The operations have been hampered by labour troubles, and the costs have increased owing to the rise in the rate of wages. Capital has been spent in developing the Great Cobar, the Chesney copper mine, and the Cobar gold mine, and when the concentrator is at work at the Chesney early next year, the company should be able to maintain a regular output from all the mines and to produce a suitable smelting mixture. The Cobar gold mine promises to be an exceedingly useful factor in the situation, providing a silicious mixture for the pyritic ores of the other mines. The monthly outputs will be 26,000 tons from the Great Cobar, 13,000 from the Chesney (to be concentrated to 5000 tons), and 9000 from the Cobar gold mine. During the 18 months under review, 386,124 tons of ore was raised from the Great Cobar, 46,137 tons from Chesney, and 43,697 tons from the Cobar gold, a total of 475,988 tons.

The smelter treated this ore and also some of the accumulated stock and purchased material, the total amount being 606,791 tons. The metals dispatched from the smelter were 9652 tons copper, 36,649 oz. gold, and 174,657 oz. silver. During the latter 6 months of the 18, the assay of the various ores were: Great Cobar, 0·98 dwt. gold, 0·429 oz. silver, and 2·508% copper; Chesney, 1·64 dwt. gold, 0·369 oz. silver, and 3·287% copper; Cobar gold, 0·5 oz. gold, 0·5 oz. silver, and 1·32% copper. On June 30 last the reserves were: Great Cobar 2,142,000 tons, Chesney 602,000 tons, and Cobar gold 344,000 tons. The total reserve at the first two has increased by 361,000 tons during the 18 months. The income during the period was £817,434, and the gross profit £102,354. Out of this £13,000 has been allowed for depreciation, £22,886 has been devoted to the purchase of debentures, and £66,492 has been paid as interest on debentures. In October 1910 50,000 new shares of £5 each were created; of these 15,000 were issued at par for cash, and 20,000 were issued as purchase price for the Cobar gold mine, so the issued capital now consists of £925,000 in shares, and there is £732,152 in debentures and debenture interest outstanding. H. C. Bellinger, the general manager, contributes full reports on the mines and smelting plant. Though the Great Cobar has given shareholders many disappointments in the past, the present position seems to be satisfactory and the future more hopeful.

Tomboy. — This company was floated by the Exploration Co. in 1899 to acquire the gold mine of that name at Telluride, Colorado. Four years later the mine showed signs of exhaustion, so the manager at the time, John Herron, acquired, on his own responsibility, on behalf of the company, the lease of an adjoining property, the Argentine. This property redeemed the fortunes of the company, and the directors and shareholders very properly granted Mr. Herron an annuity of 1% of the net yearly profits, on his retirement owing to ill-health shortly after. At first the Argentine group yielded handsome profits, but during the last three years the content has been lower. The report now published covers the year ended June 30 last, and the results disclosed are almost identical with those of the previous two years. The amount of ore raised was 116,222 tons, yielding bullion worth $462,773, and concentrate worth $350,141, the total value being $781,324. The cost was $509,057, so that the mining profit was $272,267. Profits from other local sources amounted to $37,108, bringing the total local profit to $309,375. The profit in English money was £63,860; out of this £5200 has been allowed for depreciation of plant, £4000 allocated to income tax, £546 paid to John Herron, and £60,000 distributed as dividend, being at the rate 20%. The present manager, David A. Herron, reports the ore reserve at June 30 at 427,000 tons, as compared with 444,600 tons a year ago, and he mentions that almost all the stopes have continued to disclose profitable ore. It is granted however that the resources of this property are limited. An important step was taken since the conclusion of the year under review, in July last, when the southern portion of the Revenue Tunnel company's property was acquired for £80,000. This piece of ground has only been intermittently worked by the Revenue Co., owing to the natural disadvantage of its being on the other side of the divide to the main portion. Its position is favourable to its exploitation by the Tomboy Co. At the present time a line is being built to facilitate the transport of the ore to the Tomboy mill. We publish herewith a map of the district showing the relative position of these properties and of the Camp Bird.

Stratton's Independence.—This gold mine at Cripple Creek is too well known for it to be necessary for us to recapitulate here. After a successful life as a gold producer, the mine was let to tributers, and the company's own operations confined to the treatment of low-grade dumps. Particulars of the method of treatment were given in our last issue by Philip Argall, the present manager. In 1908 the capital was written down by 87%, and now stands at £125,000 in a million shares of 2s. 6d. each. The report now issued covers the year ended June 30. It shows that the concentrating and cyanide plant treating the dump ore has been brought up to 10,000 tons per month, and that the tonnage treated during the year was 109,800, as compared with 68,711 the year before. The production was 12,361 oz., which sold for £45,788, after deducting transport and smelter charges; the cost of treatment on the spot was £33,173, and the profit £12,614. The recovery was 71½% of the estimated contents. In addition to this extraction by concentration and cyanidation of dump ore, 2752 tons of ore was raised from the mine by the company, bringing a net revenue of £5812, and 15,633 tons was raised by tributers, the company's share of the profit being £28,813. After paying for administration and London expenses, the balance available for distribution was £21,006. Out of this £12,500 has been distributed as dividend, and another dividend at the same rate has since been declared out of the profits of the current year. It is of interest to note that the caved part of the mine has been reopened by the company, and that some high grade veins have already been disclosed.



Part of Colorado, showing Tomboy and Revenue Tunnel Properties.

Uruguay Consolidated.—This company was formed in the summer of 1909 to acquire the San Gregorio gold mine at Corrales, in the State of Riveria, Uruguay. St. John Winne is chairman and W. H. Argall is on the board. Frank Holmes is manager. The report now issued covers the half-year ended March 30 last. Up to that time work had been confined to prospecting and development, to overhauling the 60-stamp mill acquired from the former owners, and to the provision of additional metallurgical plant. The capacity is now 70,000 tons per annum, but further power-generating plant will be required. Since the end of the period covered by the report, J. G. Ralph has visited the mine, and he and the manager have reported the existence of large orebodies, of unusual width, and of comparatively low grade. The proved ore on March 31 was given by Mr. Holmes at 134,838 tons averaging 3½ dwt. or 14s. 6d. per ton, which can be worked at a cost of 9s. per ton. The directors are now asking for £50,000 additional capital for the purpose of retiring the debentures and loans, and for continuing the development of the mine and improvement of the plant.

Taxco Mines of Mexico. — This company was formed in April 1910 to acquire the old Rosario silver mine in the State of Guerrero, Mexico. This mine was worked previously, but abandoned when the oxidized ore was exhausted, as the sulphide was not rich enough for shipping to the smelters. T. R Marshall reported that the sulphide is amenable to the modern method of fine grinding and cyanidation. The first annual report now issued shows that sufficient development work has been done to warrant the erection of a 100 ton cyanide plant. The ore varies greatly, but Mr. Marshall is of opinion that a constant average of 20 oz. ore can be obtained for the proposed plant. He estimates that the net profit should be not less than £1 per ton. The directors are now increasing the capital from £60,000 to £100,000 in order to provide the necessary plant and to continue development.

TRADE NOTES

Most of the trade publications mentioned in this column are available for distribution and the manager of The Mining Magazine will be pleased to secure copies for persons interested.

The British Humboldt Engineering Co., Ltd., report three orders for their Magnetic Laboratory-Type Separators, for treatment of tin, wolfram and similar ores.

John Russell & Co., Ltd., send us their catalogue of 138 pages giving useful information on tubes and fittings. It contains 17 pages of conversion tables.

Head, Wrightson & Co., Ltd., have published a catalogue describing the Hendryx Agitator. A testing plant has been equipped in London for testing ore with this process.

The Ingersoll Rand Co. now control the business of the J. Geo. Leyner Engineering Works at Littleton, Colorado. This new move marks additional progress on the part of this well known firm.

The Kilbourne & Jacobs Manufacturing Co. have sent us for our files a complete set of their catalogues describing mine cars and trucks. They are represented in London by L. B. Chandler, Broad Street House, E.C.

The New York Engineering Co. are distributing a new catalogue describing The Empire Tailing Elevator. This machine is intended to overcome the difficulty of working placer ground which will not warrant an extensive dredging plant, and where the contour of the country does not provide sufficient grade for sluicing.

Edward M. McIlvain, formerly president of the Bethlehem Steel Co. and latterly president of the Universal Vanadium Company, has resigned the latter, to accept the Presidency of the Lehigh Coke Company, which company is constructing a by-product coke oven plant at South Bethlehem, Pa. The New York office of the company is at No. 71 Broadway.

Jens Orten-Böving & Co. have made a special study of pumping and water-power plants, and are distributing to those interested a bulletin dealing more particularly with their Victoria Turbo Pump which has been installed in a number of places with great success. One of these pumps at the Lambton Collieries is working against a head of 315 feet and discharging 2900 gallons per minute and shows an efficiency of 86%.

The Bucyrus Company have increased their capital stock to $10,000,000 with $8,000,000 issued. New shops are being erected at Evansville, Indiana, in addition to the present works at South Milwaukee. It is the purpose of the company to expand their scope of business in all types of bucket, dipper, and hydraulic dredges, and steam and electric shovels, for which they have established an enviable reputation.

The Worthington Pump Co. have sent us an imposing list of their recent sales. It is interesting, not only on account of the gratifying number, but because of the varied purposes and industries for which their products are adapted. The sales include many different types of pumps: triple expansion, plunger, electrically driven, fire, high and low lift centrifugal, vacuum, etc., also surface and jet condensers, water meters and air compressors.

Hadfield's Steel Foundry Co. have issued catalogue No. 102 (9 by 11 in., 24 pages and cover) to describe the Symons Disc Crusher. This catalogue should prove of interest to every engineer interested in reducing stone or ore. The principles of crushing have undergone decided changes in the past few years, and this device appears to have particular merit. The excellent illustration and reading matter seem to have been put together with the idea of answering every conceivable question which might arise, concerning the structure and the work the crusher is intended to do. It is obvious that unless the discs, which withstand the crushing force, are made of the most durable metal, the efficiency of the machine is nil. The fact that they are made of 'Era' manganese steel is a sufficient guarantee that operators will have no unnecessary uneasiness on this point.

Holman Brothers' catalogues illustrate the high standard that can be attained in trade literature. We have received the 1912 editions of two recent publications covering Holman Hoists and Holman Rock-Drills, Compressors, and Accessories. The Hoist catalogue (9 by 12 in., 60 pages) is particularly well designed, beginning with a description of the small Stretcher-Bar machine and leading up to the large types of steam and electric winding engines. We are promised later a separate catalogue dealing with Electric Hoists only. Approximate prices for the smaller hoists are given. Each type of machine is illustrated by a large photographic reproduction, and from the amount of information given, the prospective user should find all the necessary data to formulate an order for his particular requirements. The catalogue on Rock-Drills and Compressors is smaller (5½ by 9 in. 94 pages). The list of users of Holman Drills and the letters of appreciation are convincing. It is interesting to note that the works of this company have been enlarged four times in the half century of their useful existence.

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